EPA-9-CA-South Bay Dischargers Authority - 78

DRAFT
ENVIRONMENTAL IMPACT REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

SOUTH BAY DISCHARGERS AUTHORITY
TREATED WASTEWATER DISPOSAL PROGRAM

November, 1978

Prepared by:
U.S. Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, California 94105

and
South Bay Dischargers Authority
801 North First Street
San Jose, California 95110

With technical assistance from:
Bechtel Inc.
50 Beale Street
San Francisco, California 94119

In association with:
E. H. Smith and Associates
Archaeological Consulting and Research Services, Inc.
Mr. Michael Melanson
R. C. Harlan and Associates
Pacific Environmental Laboratory
Hydroscience, Inc.

Grant No. CA-06-1135

RESPONSIBLE OFFICIALS:

Frank M. Covington

for Paul De Falco, Jr.
Regional Administrator
Environmental Protection Agency
Region IX

Franklin D. Knofler

Franklin D. Knofler
Acting Chief Executive Officer
South Bay Dischargers Authority

A

NOV 29 1978

To All Interested Agencies, Public Groups, and Concerned Individuals:

The Draft Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) for the South Bay Dischargers Authority Treated Wastewater Disposal Program is complete and is being distributed at this time for your review and comment. This program would provide a wastewater disposal system for the San Jose/Santa Clara, Sunnyvale, and Palo Alto wastewater treatment plants, located in the Santa Clara County Baylands along the southeastern edge of San Francisco Bay. The Draft EIR/EIS has been prepared to conform with the requirements of the National Environmental Policy Act of 1969 and the California Environmental Quality Act of 1970, as amended.

The project alternative has not been selected. However, the Environmental Protection Agency (EPA) and the South Bay Dischargers Authority (SBDA), at this time, recommend a "no project alternative" for the following reasons:

1. The degree to which increased dilution resulting from a discharge north of the Dumbarton Bridge will mitigate the adverse impacts of toxicants on the biota of the South Bay cannot be predicted.
2. Modeling studies have not shown that a substantial improvement in dissolved oxygen concentrations would result if the discharges were moved north of the Dumbarton Bridge.
3. The viability of future full reclamation is being investigated in the Regional Wastewater Reclamation Study. Should such an alternative prove to be feasible, it would meet the planning requirements of the San Francisco Bay Basin Plan.

The EPA and the SBDA recognize that comprehensive receiving water monitoring will be needed to document the impacts of wastewater discharges in the South Bay after treatment facilities, now under construction, are placed in full operation. In addition, each discharging agency is committed to local and regional wastewater reclamation investigations.

This decision is being recommended by EPA and SBDA, based upon present knowledge. However, if the final selection is a "no project alternative," we will continue to evaluate results of the monitoring program and will reconsider our selection, if appropriate.

The Final EIR/EIS will identify the project alternative selected after consideration of the public comments.

Comments on the Draft EIR/EIS should be sent to this office within 45 days of the date of this letter. All comments received will be considered in preparation of the Final EIR/EIS for this action. If you fail to comment within the specified time, it shall be assumed, absent a request for a specific extension of time, that you have no comment to make.

In order to receive testimony from the public, EPA will hold a public hearing on the Draft. It is presently anticipated that the hearing will be held in January or early February 1979. Public notice will be given in the local newspapers at least thirty days in advance of the public hearing.

The hearing may be continued from time to time, or to a different place, after its commencement, to accommodate the need of witnesses or the EPA.

All interested parties are invited to express their views at this hearing. Persons wishing to make comments may submit them in writing and/or appear at the hearing. Written comments should be submitted in triplicate to:

U.S. Environmental Protection Agency
Region IX
Attn: Hearing Office (HE-141)
215 Fremont Street
San Francisco, CA 94105

b

Oral statements will be received and considered, but, for accuracy of the record, all important testimony should be submitted in writing. Oral statements should summarize extensive written materials so that there will be time for all interested persons to be heard. Enough copies of the written materials should be produced so that other interested persons may receive a copy and there will be no necessity for written materials to be read at length.

The following documents constitute the Draft EIR/EIS:

Summary
Main Text
Appendices (2 volumes)

The Draft may be reviewed at the following locations:

U.S. Environmental Protection Agency
Region IX
Library
215 Fremont Street
San Francisco, CA 94105

U.S. Environmental Protection Agency
Public Reference Unit (P.M. 213)
401 M Street, S.W., Room 2922
Washington, D.C. 20460

Documents Librarian
Santa Clara County Library
Research Center
10400 Torre Avenue
Cupertino, CA 95014

San Jose Public Library
180 W. San Carlos St.
San Jose, CA 95110

Palo Alto Public Library
1213 Newell Rd.
Palo Alto, CA 94303

Santa Clara County Library
7387 Rosanna St.
Gilroy, CA 95020

Santa Clara County Library
78 South Dempsey Rd
Milpitas, CA 95035

Mountain View Public Library
585 Franklin Street
Mountain View, CA 94040

Library
Water Resources Center
University of California
Berkeley, CA 94720

Santa Clara Public Library
2635 Homestead Road
Santa Clara, CA 95051

Sunnyvale Public Library
Attn: Documents Librarian
665 W. Olive Avenue
Sunnyvale, CA 94086

Santa Clara County Library
1095 North 7th Street
San Jose, CA 95112

NASA Ames Research Center
Technical Library
Moffett Field
Sunnyvale, CA 94040

City of San Jose
Planning Department
801 North First Street
San Jose, California 95110

City of Santa Clara
Planning Department
1500 Warburton Avenue
Santa Clara, CA 95050

City of Mountain View
Planning Department
540 Castro Street
Mountain View, CA 94040

City of Sunnyvale
Planning Department
P.O Box 607
456 W. Olive Avenue
Sunnyvale, CA 94088

City of Los Altos
Planning Department
1 N. San Antonio Road
Los Altos, CA. 94022

City of Palo Alto
Planning Department
250 Hamilton Street
Palo Alto, CA 94301

City of Milpitas
Planning Department
455 E. Calaveras Blvd.
Milpitas, CA 95035

City of Cupertino
Planning Department
City Hall, 10300 Torre Ave
Cupertino, CA 95014

Town of Los Altos Hills
Planning Department
26379 Fremont Road
Los Altos Hills, CA 94022

City of Los Gatos
Planning Department
P.O. Box 949
Los Gatos, CA 95030

City of Monte Sereno
Planning Department
18041 Saratoga-Los Gatos Road
Monte Sereno, CA 95030

Please bring this notice to the attention of all persons who would be interested in this matter.

U.S. Environmental Protection Agency, Region IX

Frank M Covington
by for Paul De Falco, Jr.
Regional Administrator

South Bay Dischargers Authority

Franklin D. Knofler
by Franklin D. Knofler
Acting Chief Executive Officer

D

Foreword

The purpose of this report is to evaluate and disclose the environmental impact associated with the project alternatives developed and considered to meet the requirements of the *Water Quality Control Plan, San Francisco Bay Region* (SWRCB and RWQCB, 1975) for the management of South Bay Dischargers Authority (SBDA) wastewater in the San Francisco Bay area.

E

SOUTH BAY DISCHARGERS AUTHORITY
TREATED WASTEWATER DISPOSAL PROGRAM

DRAFT

ENVIRONMENTAL IMPACT REPORT AND STATEMENT

SOUTH BAY DISCHARGERS AUTHORITY and

REGION IX
U.S. ENVIRONMENTAL PROTECTION AGENCY

In order to assist the reader of this Draft EIR/EIS in finding sections of particular interest or value, the following table of correlation has been formulated, indicating which of the sections listed in the TABLE OF CONTENTS correspond to the titles and subjects required by the California Environmental Quality Act, as amended:

CEQA	DRAFT EIR/EIS SECTION NUMBER
DESCRIPTION OF PROJECT	I
• Precise location and boundaries	I:2.1 and Figure I-7
• Objectives sought	I.1.2
• General description of the project	I.1 and I.2
DESCRIPTION OF ENVIRONMENTAL SETTING	II, V.2 and VI.2
• Rare or unique resources	II.1.2, II.1.3 and II.2.1
• Public and private projects in the region	II.2
ENVIRONMENTAL IMPACT	III, IV, V.4, V.6, VI.3 and VI.4
• Significant environmental effects	III.1, V.4, V.6 and VI.3
• Effects which cannot be avoided	II.2 and VI.4.1
• Mitigation measures proposed	III.3 and VI.4.2
• Alternatives	I.1, I.2, IV, V and VI
• Local short-term users vs. maintenance and enhancement of long-term productivity	III.4 and VI.4.3
• Irreversible changes	III.5 and VI.4.4
• Growth-inducing impact	III.6 and VI.4.5
EFFECTS FOUND NOT TO BE SIGNIFICANT	III.1
ORGANIZATIONS AND PERSONS CONSULTED	VII
• Consulted agencies, organizations or individuals	VII.3
• Preparers of Draft EIR/EIS	VII.2
WATER QUALITY ASPECTS	III, V.6.1, V.6.4 and VI.3

CONTENTS

Section — Page

I DESCRIPTION OF BASIN PLAN AND ALTERNATIVES

I.1 DESCRIPTION OF ALTERNATIVES 1
I.1.1 Introduction 1
I.1.2 Background and Objectives 4
I.1.3 Criteria for Evaluation of Alternatives 6
I.1.4 Evaluation of Alternatives 6
Alternative 2 — No Further Action 9
Alternative 3 — Individual Outfalls to Nearest Deepwater 10
Alternative 4 — Local Discharge with Upgraded Treatment 11
Alternative 5 — Reclamation and Reuse of Treated Wastewater 13
I.1.5 Alternative Alignments to Basin Plan Alternative 15
I.2 THE BASIN PLAN ALTERNATIVE 19
I.2.1 Location 19
I.2.2 Facilities for the Basin Plan Alternative 21
San Jose/Santa Clara Pumping Station 22
Pipeline Segment — San Jose Santa Clara to Sunnyvale 22
Sunnyvale Pumping Station 22
Pipeline Segment — Sunnyvale to Palo Alto 24
Palo Alto Pumping Station 24
Pipeline Segment — Palo Alto to Discharge Point 24
Diffuser 24
I.2.3 Construction of the Basin Plan Alternative 25
Construction Procedures on Land 25
Construction Procedures in Water 26
I.2.4 Operation of the Basin Plan Alternative 28
I.3 APPROVALS REQUIRED 29

II ENVIRONMENTAL DESCRIPTION

II.1 PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT) 31
II.1.1 Physical Environment 31
Topography 31
Geology and Seismology 33
Groundwater 33
Soils 36
Sediments 37
Meteorology 39
Air Quality 40
— The Air Pollution Problem in the Bay Area 40
— Emissions and Air Quality 40
— Air Quality in the Bay Area 45
— Air Impacts of Wastewater Disposal 45
Hydrology 45
— Tides and Currents 46
— Circulation and Dispersion 47
Water Quality 49
— Temperature 51
— Transparency 51
— pH 51
— Suspended Solids 51
— Salinity 52
— Dissolved Oxygen and Oxygen Demand 53
— Nutrients 53
— Chlorophyll 54
— Coliform Bacteria 54
— Oil and Grease 55
— Toxicity 55
— Heavy Metals 57
Noise 57
II.1.2 Biological Environment 58
South Bay Habitats 58
— Open Water 61
— Tidal Mud Flats 64
— Salt Marsh 68
— Salt Ponds 71
Dikes and Levees 74
— Grasslands 75
— Streams and Sloughs 75
— Freshwater Marshes and Ponds 77
Species of Special Concern 78

II.1.3 Social, Economic, and Cultural Environment 83
  Population and Demography 83
  Recreational and Scientific Uses of the Area 87
  Archaeological, Paleontological, Historical and Cultural Resources 88
    — Archaeological Resources 88
    — Paleontological Resources 89
    — Historical and Cultural Resources 89
  Visual and Aesthetic Setting 93
  Economic Setting 98
II.2 LAND USE
II.2.1 Present Land-Use Patterns 101
  Existing Land Use 101
    — Santa Clara County 101
    — San Mateo County 104
  Existing Public and Private Developments 104
  Mineral Resources of the Baylands 112
II.2.2 Projected Land-Use Patterns 112
  Planned Public and Private Developments 112
  Land-Use Plans and Planning Agencies 114
  Interested Agencies 118
    — Local 118
    — Regional 118
    — State 118
    — Federal 119
II.3 WATER USE
II.3.1 Existing and Proposed Wastewater Treatment Facilities 120
  San Jose/Santa Clara Regional Water Pollution Control Plant 120
  Sunnyvale Water Pollution Control Plant 120
  Palo Alto Treatment Plant 121
  Menlo Park Sanitary District Wastewater Treatment Plant 121
  Redwood City Sanitary District — Redwood City Sewage Treatment Facility 121
  Redwood City Sanitary District — Redwood Shores Plant 122
  Belmont/San Carlos Joint Sewage Treatment Facility 122
  Proposed Redwood Shores Subregional Plant 122
  Union Sanitary District — Alvarado, Plant No. 3 122
  Union Sanitary District — Newark, Plant No. 1 122
  Union Sanitary District — Irvington, Plant No. 2 122
II.3.2 Current and Projected Sources of Water 122
II.3.3 Current Water Use and Projected Demand 123
II.3.4 Current and Projected Water Quality 123

III ENVIRONMENTAL IMPACTS

III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129
III.1.1 Construction Impacts 129
  Physical Environment 129
    — Topography 129
    — Air Quality 130
    — Water Quality 131
    — Sediment Quality 132
    — Noise 132
  Biological Environment 133
    — Segment I — San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134
    — Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant 136
    — Segment III — Palo Alto Treatment Plant to Discharge Point 138
  Social, Economic, and Cultural Environment 140
    — Recreational Uses of the Area 140

— Archaeological, Paleontological, and Historical Resources 141
— Visual and Aesthetic Setting 141
— Economic Setting 141
— Present Land-Use Patterns 143
— Projected Land-Use Patterns 144
III.1.2 Operation Impacts 144
Physical Environment 144
— Hydrology 144
— Water Quality 144
— Sediment Quality 148
— Noise 150
Biological Environment 152
Social, Economic, and Cultural Environment 154
— Recreational Uses of the Area 154
— Visual and Aesthetic Setting 155
— Present and Future Land-Use 155
— Energy Consumption 155
III.1.3 Economic Impact of the Basin Plan Alternative 155
Introduction 155
Study Assumptions and Methodology 155
— Capital Costs 156
— Operation and Maintenance Costs 158
Computation of Allocation Factors 158
User Charges to Discharger Groups 159
— Residential Dischargers 159
— Commercial Dischargers 159
— Industrial Dischargers 159
— Direct Impact on Industrial Dischargers 162
Analysis of the Canned Fruit and Vegetable Industry 163
— Industry Characteristics 163
— Methodology 164
— Conclusions of Analysis 165
Conclusions 165
III.1.4 Accident or Natural Catastrophe 166
Flooding 166
Earthquake 166
Plant Upset 166
Pumping Station Malfunction 166
III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168
III.2.1 Adverse Construction Effects 168
Physical Environment 168
Biological Environment 168
Social, Economic, and Cultural Environment 168
III.2.2 Adverse Operational Effects 169
Physical Environment 169
Biological Environment 169
Social, Economic, and Cultural Environment 169
III.3 MITIGATION MEASURES 170
III.3.1 Mitigation of Construction Impacts 170
Proposed Measures 170
Potential Measures 172
III.3.2 Mitigation of Operation Impacts 173
Proposed Measures 173
Potential Measures 173
III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174
III.4.1 Short-Term Uses of Man's Environment 174
III.4.2 Maintenance and Enhancement of Long-Term Productivity 174
III.4.3 Need for the Project 175
III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176
III.5.1 Permanent Changes in Land Features and Land Use 177
III.5.2 Biological Systems 177
III.5.3 Assimilative Capacity of the Bay 177
III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177
III.6 GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178

IV ALTERNATIVES TO THE BASIN PLAN

IV.1 INTRODUCTION 181
IV.2 ALTERNATIVES 182

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183
Participation by Other Entities 184
Alternative Alignments 184
Result of Screening 185
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188
Result of Screening 190
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190
Result of Screening 191
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193
Result of Screening 195
IV.2.5 Alternative 5 — Reclamation and Reuse 195
Reclamation in Santa Clara County 197
Smaller Reuse Markets in the Service Area 199
Markets Outside the Service Area 201
Result of Screening 202
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202
Result of Screening 203
IV.2.7 Alternative 7 - Discharge to the Ocean 203
Result of Screening 204
IV.2.8 Alternative 8 — Land Disposal 204
Result of Screening 205
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206
Result of Screening 206

V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION

V.1 INTRODUCTION 207
V.2 STUDY AREA 209
V.2.1 Location of Study Area 210
V.2.2 Water Demand and Supply 210
V.2.3 Quality of Groundwater Supplies 213
V.2.4 Quality of Soils 213
V.2.5 Agricultural Land Use 215
V.3 CONCEPTUAL DESIGN 217
V.3.1 Potential Markets 218
V.3.2 Reclaimed Water Quality 219
Source Control 221
Level of Reclaimed Water Treatment 222
V.3.3 Treatment Conceptual Designs 224
Reclaimed Water Flow Diversion 226
Coagulation and Sedimentation with Alkalinity Control 226
Alkalinity Control 230
Partial Desalination Treatment 232
V.3.4 Conveyance and Distribution Conceptual Designs 233
Pumping 234
Conveyance Pipeline 235
Santa Clara Valley Distribution System 236
Bolsa Distribution System 236
User Connections 236
V.3.5 Cost Estimates 242
Basis of Estimate 242
Engineering Construction Management Contingency 244
Escalation 244
Schedule 244
Operation and Maintenance 244
Major Exclusions 244
Assumptions 244
V.3.6 Blending Alternatives 244
Blended Water Quality 245
Blended Water Markets 245
Blended Water Distribution 246
Blending System Alternatives 247
V.3.7 Alternating Supply Alternatives 247
V.3.8 Summary 248
V.4 AGRICULTURAL IMPACTS 249
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250
Salinity Effects 251
Effects of High Sodium Concentrations 253

Specific Ion Toxicity 255
Summary of Effects on Agriculture of Cases A and B 255
V.4.2 Impact of Cases C, D, B_1, B_2, and B_3 in the Santa Clara County Portion of the Study Area 256
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257
V.5 ECONOMIC IMPACT ANALYSIS 259
V.5.1 Conceptual Level Costs 259
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260
V.5.3 Economic Impact on Agriculture 260
V.6 OTHER IMPACTS 263
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264
V.6.2 Long-Term Buildup of Salts in Soil 265
V.6.3 Public Health Concerns 265
V.6.4 Effects on Land Use and Water Use 266
V.6.5 Energy Consumption 266
V.6.6 Other Effects 267

VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270
VI.1.1 Disposal of Bittern 271
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273
VI.1.4 Other Disposal Alternatives 276
Continued Storage 276
On-Land Dilution 276
VI.2 PRESENT ENVIRONMENT 277
VI.2.1 Physical Environment 277
Topography 277
Soils 278
Sediments 278
Hydrology 278
Water Quality 278
— Temperature and Salinity 278
— Chemical Characteristics 280
VI.2.2 Biological Environment 280
Open Water and Tidal Mud Flats 280
Salt Marsh 280
Salt Ponds 280
Dikes and Levees 282
Streams and Sloughs 282
Species of Special Concern 283
VI.2.3 Social and Cultural Environment 283
Recreational Uses of the Area 283
Archaeological, Paleontological, Historical, and Cultural Resources 284
Visual and Aesthetic Setting 284
Existing and Proposed Land Use 284
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285
VI.3.1 Discharging to Basin Plan Alternative 285
Construction Impacts — Physical Environment 285
— Topography 285
— Air Quality 285
— Water Quality 286
— Sediment Quality 286
— Noise 286
Construction Impacts — Biological Environment 286
— Salt Pond Dikes 286
— Open Water 286
Construction Impacts — Social, Economic, and Cultural Environment 287
— Recreational Uses of the Area 287
— Archaeological, Paleontological, and Historical Resources 287
— Economic Setting 287
— Present and Projected Land-Use Patterns 287
Operational Impacts — Physical Environment 287
— Water Quality 287
— Sediment Quality 290
— Noise 290
Operational Impacts — Biological Environment 291

Operational Impacts — Social, Economic, and Cultural Environment 292
— Economic Setting 292
VI.3.2 Discharging Through Separate Diffusers 292
Construction Impacts — Physical Environment 292
— Topography 292
— Air Quality 292
— Water Quality 292
— Sediment Quality 292
— Noise 292
Construction Impacts — Biological Environment 293
— Salt Pond Dikes 293
— Open Water 293
Construction Impacts — Social, Economic, and Cultural Environment 293
— Recreational Uses of the Area 293
— Visual and Aesthetic Setting 293
— Economic Setting 293
— Present and Projected Land-Use Pattern 294
Operational Impacts — Physical Environment 294
— Water Quality 294
— Sediment Quality 295
— Noise 295
Operational Impacts - Biological Environment 296
Operational Impacts — Social, Economic, and Cultural Environment 297
— Economic Setting 297
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298
VI.4.1 Unavoidable Adverse Environmental Impacts 298
VI.4.2 Mitigation Measures 298
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299
Short-Term Uses of Man's Environment 299
Maintenance or Enhancement of Long-Term Productivity 299
Need for the Project 299
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302
Permanent Changes in Land Features and Land Use 302
Biological Systems 302
Assimilative Capacity of the Bay 302
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302
VII SOURCES OF INFORMATION
VII.1 REFERENCES 305
VII.1.1 Literature Cited in Text 305
VII.1.2 Literature Cited in Figures 312
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313
VII.3 CONTACTS 316
VII.4 DISTRIBUTION LIST 335
VII.4.1 Federal Agencies 335
VII.4.2 Libraries 338
VII.4.3 Individuals and Private Groups 339
VII.4.4 State Agencies 347
VII.4.5 Regional Agencies and Local Government 348
VII.4.6 Legislators 352
VII.4.7 News Media 353

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

TABLES

Table Page

I-1 Alternatives Evaluated in this Series 7
I-2 Reclamation Alternatives Evaluated by Consoer-Bechtel 14
I-3 Basin Plan Alternative Design Criteria, 1995 21
I-4 San Jose/Santa Clara Pumping Station Characteristics 22
I-5 Sunnyvale Pumping Station Characteristics 24
I-6 Palo Alto Pumping Station Characteristics 25
I-7 Listing of Potential Agency and Permit Requirements 29
II-1 Groundwater Quality of Santa Clara Basin, South Bay Area 36
II-2 South Bay Dischargers Authority Proposed Joint Outfall Pipeline Alignment Preliminary Sediment Description 39
II-3 Environmental Protection Agency, Region IX Dredge Spoil Disposal Criteria (Revision 2) for Polluted Spoil 39
II-4 Number of Days Air Quality Standards Exceeded at Selected Stations During 1976 45
II-5 Variations in Maximum Ebbtide Current Velocities Near Dumbarton Bridge 46
II-6 Timing, Direction, and Duration of Tidal Velocities at Dumbarton Bridge 46
II-7 Summary of Water Quality Characteristics of Central and South San Francisco Bay, 1958-1964 50
II-8 Comparison of Serl Water Quality Data and Recent (1975-1977) Monitoring Station Data 51
II-9 Heavy Metal Loadings to South Bay from SBDA, 1976-7 58
II-10 Existing Noise Levels Near and Along the Proposed Pipeline Alignment 61
II-11 Common Species at Benthic Stations on or in the Vicinity of Recommended Pipeline Alignment 65
II-12 Endangered Species of South San Francisco Bay 79
II-13 Population and Density Growth in California, San Francisco Bay Area, Santa Clara County, and San Mateo County, 1900-1977 85
II-14 January 1, 1977, Population Estimates for Santa Clara and San Mateo County Cities within the SBDA Service Area and the San Mateo County Study Area 86
II-15 Projected Population in the Santa Clara County Portion of the SBDA Service Area 87
II-16 Projected Population in the San Mateo County Portion of the SBDA Service Area 87
II-17 Number of Employees, Santa Clara County, 1950-1974 99
II-18 Employment Projections for Selected Industries in Santa Clara County, 1975-2000 100
II-19 Land-Use Patterns in the Baylands of Santa Clara County Compared with Countywide Land Use, 1967 101
II-20 Agricultural Productivity in Santa Clara Baylands 104
II-21 Land-Use Patterns in the Baylands of San Mateo County Compared with Countywide Land Use, 1972 105
II-22 Projected Land-Use Patterns, 1975-2000, for Santa Clara and San Mateo Counties 113
II-23 Sources of Water Supply for the Santa Clara Valley 123
II-24 Existing Water Supply Facilities, Santa Clara County 124
II-25 South Bay Aqueduct Water Deliveries 125
II-26 Unadjusted Residential Water Demands, Santa Clara County 126
II-27 Projected Total Water Demand, Santa Clara County 127
II-28 Projected Total Water Demand, Santa Clara County 127

Table Page

II-29 TDS Concentrations of Major Water Import Sources, Santa Clara County 128
II-30 Summary of Groundwater Quality in Santa Clara Valley — South Bay Area 128
II-31 Coyote and Uvas Creek Water Quality, 1952-1967 128
III-1 Predicted Maximum Noise Levels from Construction Equipment and Pile Driving Activities 133
III-2 Biological Habitats in or Adjacent to the Proposed Basin Plan Alternative 135
III-3 Estimated Distribution of Construction-Related Wages and Salaries 1979-1981 in 1975 Dollars 143
III-4 Assumed Pump Operating Conditions 151
III-5 Capital Cost Summary 156
III-6 Distribution of Federal, State, and Local Shares of Capital Cost to Member Cities 157
III-7 Annual Flow Volumes of Cities and Computation of Operation and Maintenance Cost Shares 158
III-8 Computation of Allocation Factors and User Charges 160
III-9 Allocation Factors and Total Annual Revenue Requirements for San Jose/Santa Clara, Sunnyvale and Palo Alto 161
III-10 Annual Revenue Requirement and Average User Charge to Residential Dischargers in San Jose, Santa Clara, Sunnyvale, and Palo Alto 162
III-11 Annual and Average Annual Revenue Requirements for Commercial Establishments in San Jose, Santa Clara, Sunnyvale, and Palo Alto 162
III-12 Annual Revenue Requirements for Industrial Dischargers in San Jose, Santa Clara, Sunnyvale, and Palo Alto 163
IV-1 Reclamation and Reuse Markets Identified by Consoer-Bechtel (1973) 197
IV-2 Reclamation Alternatives Evaluated by Consoer-Bechtel (1973) 199
V-1 Irrigation Water Requirements for Crops in Santa Clara County Study Area 213
V-2 Irrigated Acreages by Crop in Bolsa Study Area 214
V-3 Groundwater Quality in Study Area 214
V-4 Crop Production Data for Santa Clara County 216
V-5 Crop Production Data for the Bolsa Area of San Benito County 216
V-6 Yearly Demand for Water in Santa Clara County 220
V-7 Water Quality Criteria for Irrigation Waters 220
V-8 Characterization of Projected Effluent from the San Jose/Santa Clara Water Pollution Control and Advanced Wastewater Treatment Facility 221
V-9 Projected Water Quality for Four Treatment Levels 223
V-10 Design Components 225
V-11 Matrix of Alternatives 225
V-12 Reverse Osmosis Design 234
V-13 Design Characteristics of Santa Clara Valley Wastewater Distribution System 238
V-14 Bolsa Distribution System 241
V-15 Cost Estimate Summary All Components 243
V-16 Water Quality of Alternative Blended Waters 245
V-17 Predicted Composition of Case A Treatment Scheme Wastewater 251
V-18 Predicted Composition of Case B Treatment Scheme Wastewater 251
V-19 Decrement to be Expected for Certain Crop Yields Due to Increased Salinity in Soil 253
V-20 Effect of Increased Salinity on Agricultural Productivity and Gross Income/Year 254
V-21 Effects of Specific Ions on Sensitive Crops 255

Table Page

V-22 Predicted Composition of Cases C, D, B_1, B_2, and B_3 Treatment Scheme Wastewaters 257
V-23 Capital, Annual Operation and Maintenance Costs, and Energy Costs for the Five Categories of Reclaimed Water Treated and Conveyed to Either South Santa Clara or Bolsa Area 261
V-24 Real Economic Costs to Treat and Convey Reclaimed Wastewater to either the South Santa Clara or Bolsa Area 262
V-25 Unit Cost of Reclaimed Wastewater to the Santa Clara Valley Water District Assuming 87.5 Percent State/Federal Grant Funding of the Capital Costs 262
V-26 Cost of SCVWD Water to Agricultural Users in South Santa Clara County for the Reclaimed SBDA Wastewater Options Estimated for the Year 1985-1986 263
VI-1 Chemical Analysis of Bay Water and Bittern 272
VI-2 Sediment Sample Analyses and EPA (1975) Dredge Spoil Disposal Criteria for Polluted Spoil 278
VI-3 Variation in Salinity and Temperature at Dumbarton Bridge 279
VI-4 Chemical Analysis of San Francisco Bay Water in Vicinity of Dumbarton Bridge 281
VI-5 Common Species at Benthic Stations Near Dumbarton Bridge 282
VI-6 Comparison of SBDA Discharging Alone with Adverse Environmental Impacts of Bittern Disposal Alternatives 300
VI-7 Resources Committed to the Leslie Salt Bittern Disposal Alternatives 303

BLANK PAGE

ILLUSTRATIONS

Figure Page

I-1 Basin Plan Alternative — On-Land Alignment 2
I-2 Schematic — Alternative 2 9
I-3 Schematic — Alternative 3 10
I-4 Schematic — Alternative 4 11
I-5 Schematic — Alternative 5 13
I-6 Alternative Alignments — On-Land and Estuarine 17
I-7 Study Area Location and Principal Municipalities 20
I-8 Conceptual Pumping Station Layout, San Jose/Santa Clara 23
I-9 Conceptual Pumping Station Layout, Sunnyvale 23
I-10 Conceptual Pumping Station Layout, Palo Alto 26
I-11 Typical Construction 27
II-1 Topography 32
II-2 Saltwater Flooding 34
II-3 Geology and Seismology 35
II-4 Sediment Boring Locations 38
II-5 Averages of Meteorological Parameters Measured at San Jose and San Francisco Airports 41
II-6 Annual Wind Direction Frequency and Mean Wind Speed by Direction 42
II-7 Profile of Air Pollution in the San Francisco Bay Area 43
II-8 Emissions Profile for the San Francisco Bay Area, 1975 44
II-9 Intertidal Velocities From Hydrodynamic Model 47
II-10 Net Circulation Pattern for San Francisco Bay 48
II-11 Seasonal Variation of Water Temperature at Several Locations in San Francisco Bay 52
II-12 Noise Survey 59
II-13 Two Schematic Cross-Sections of the Baylands of South San Francisco Bay 60
II-14 Habitat Map 62
II-15 Biological Surveys 66
II-16 Palo Alto Baylands Reserve 70
II-17 Salt Ponds in the South Bay 72
II-18 Rare and Endangered Species and Species of Special Concern 80
II-19 Population Growth in California, San Francisco Bay Area, and Santa Clara and San Mateo Counties, 1910-1975 83
II-20 Wildlife Refuge, Parks and Recreation Areas 90
II-21 Archeological - Paleontological Deposits 94
II-22 Historical Sites, Landmarks, and Residences 96
II-23 1975 Land Use 102
II-24 Existing Public and Private Facilities 106
II-25 Future Land Use 116
III-1 Mean Dissolved Oxygen Levels Resulting From Implementation of the Basin Plan Alternative 149
III-2 Projected Salinity in the South Bay Resulting From Implementation of the Basin Plan Alternative 150
III-3 Relative Toxicity in the South Bay Resulting From Implementation of the Basin Plan Alternative 150
III-4 SBDA-EPA-Bechtel-Economic Impact Analysis — Santa Clara County Canning Industry Survey Data Sheet 164
III-5 Surveyed Canned Fruit and Vegetables Industry Gross Revenue, Cost of Operation 165
IV-1 Schematic — Alternative 1 183
IV-2 Alternative Alignments — On-Land and Estuarine 186
IV-3 Schematic — Alternative 2 188
IV-4 Water Quality Parameters Associated With Alternative 2 189
IV-5 Schematic — Alternative 3 190
IV-6 Water Quality Parameters Associated With Alternative 3 192
IV-7 Schematic — Alternative 4 193

Figure | Page
IV-8 Water Quality Parameters Associated With Alternative 4 194
IV-9 Schematic — Alternative 5 196
IV-10 Schematic — Alternative 6 202
IV-11 Schematic — Alternative 7 203
IV-12 Schematic — Alternative 8 204
V-1 Agricultural — South Santa Clara Valley 211
V-2 Agricultural Lands — Bolsa Area 212
V-3 South Bay Dischargers Authority Waste-Water Reclamation Project Process Flow Diagram 227
V-4 Proposed Reclamation Facilities, San Jose-Santa Clara Water Pollution Control Plant 228
V-5 Coagulation and Sedimentation Treatment Process Flow Diagram 229
V-6 Coagulation and Sedimentation Layout 231
V-7 Flow Diagram — Desalination Process 232
V-8 Conceptual Layout — Main Pump Station 233
V-9 Conceptual Plan View of Main Pump Station — Lower Level 235
V-10 Santa Clara Valley Distribution System 237
V-11 Bolsa Area Distribution System 240
V-12 Effect of Treatment Level on Water Cost 249
VI-1 Leslie Salt Company Bittern Disposal System — Discharge to SBDA Diffuser 274
VI-2 Leslie Salt Company Bittern Disposal System — Separate Diffuser 275
VI-3 Mean Dissolved Oxygen Levels Resulting From Leslie Salt Company Bittern Being Discharged in Common Diffuser With SBDA 288
VI-4 Relative Toxicity in the South Bay Resulting From Leslie Salt Company Bittern Being Discharged in a Common Diffuser With SBDA 289
VI-5 Projected Salinity in the South Bay Resulting From Leslie Salt Company Bittern Being Discharged in a Common Diffuser With SBDA 290
VI-6 Relative Toxicity in the South Bay Resulting From Leslie Salt Company Bittern Being Discharged From a Separate Diffuser Near Dumbarton Bridge 295

Section I

DESCRIPTION OF BASIN PLAN AND ALTERNATIVES

1-A

I.1

DESCRIPTION OF ALTERNATIVES

I.1.1 INTRODUCTION

Project alternatives were developed for various methods of disposal of the wastewater treatment plant effluents from the SBDA member cities and associated agencies. These effluents are presently discharged to the shallow sloughs of South San Francisco Bay in violation of instructions against discharge into the Bay south of the Dumbarton Bridge.

The SBDA is a public agency comprising four cities and their associated agencies:

- San Jose and Santa Clara
    - Burbank Sanitary District
    - Cupertino Sanitary District
    - Sunol Sanitary District
    - County Sanitation District No. 2
    - County Sanitation District No. 3
    - County Sanitation District No. 4
    - City of Campbell
    - City of Monte Sereno
    - Town of Los Gatos
    - City of Saratoga
    - Milpitas Sanitary District
    - City of Milpitas
- Sunnyvale
    - Moffett Field

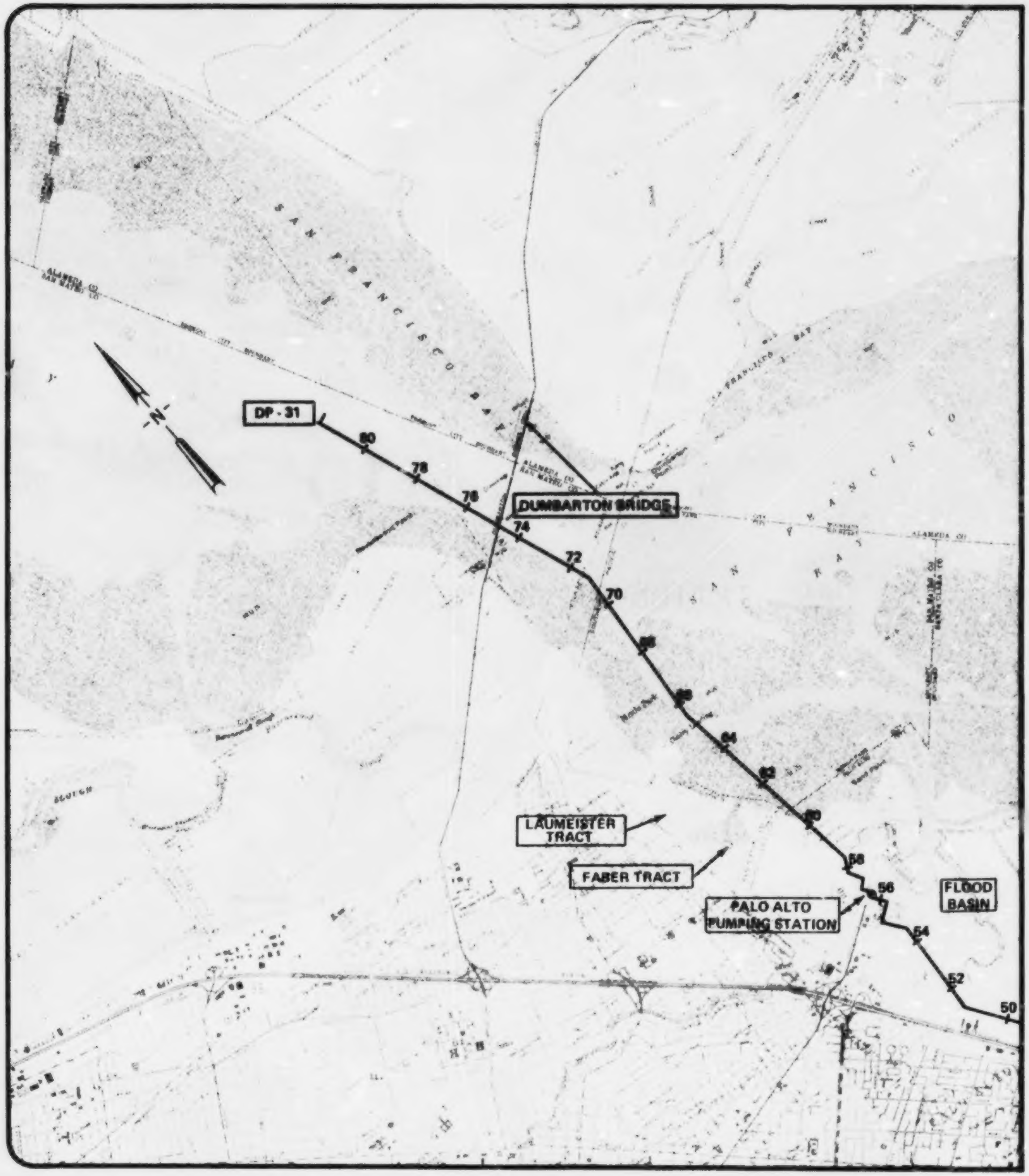
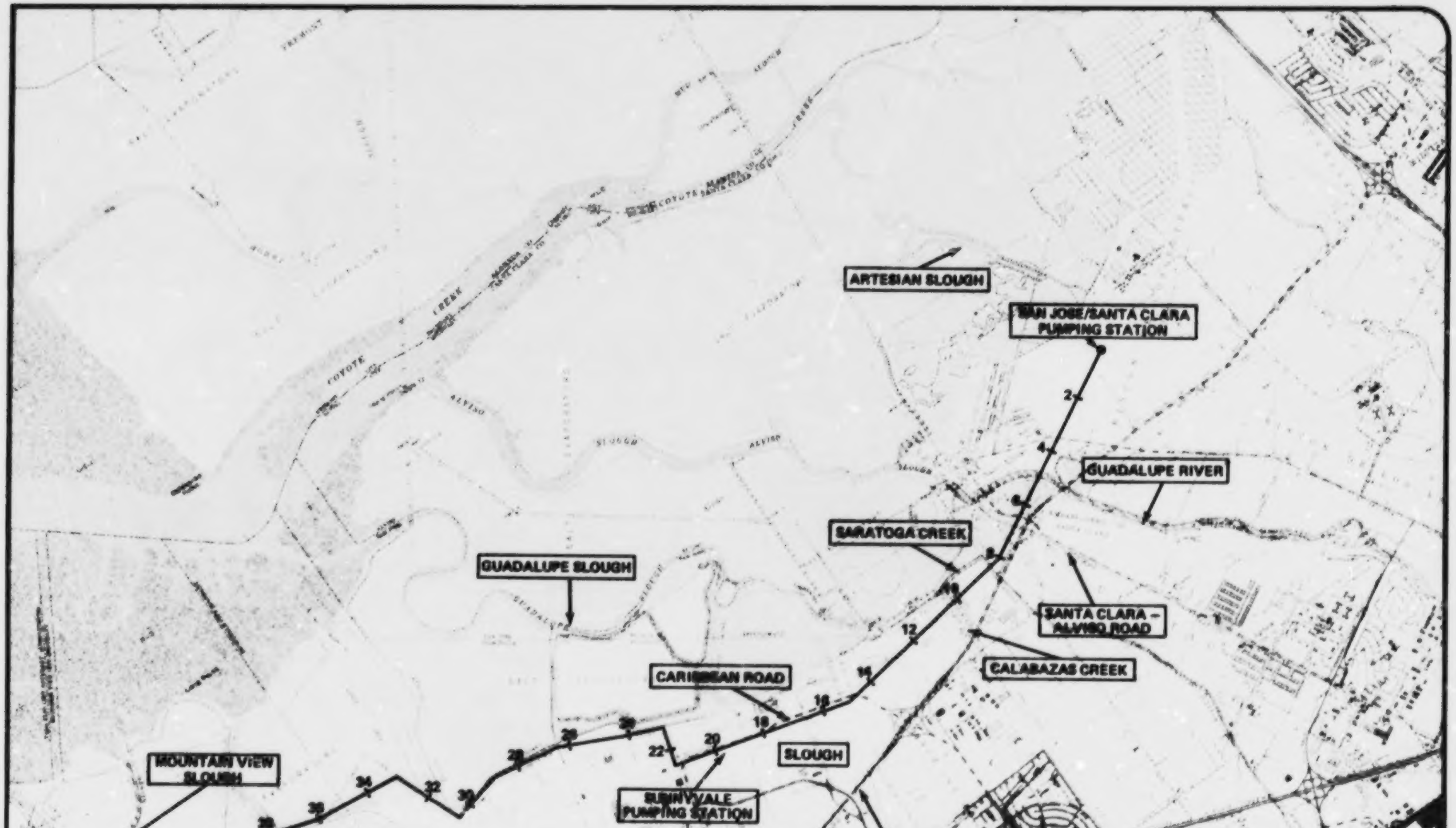

35
PIPELINE STATIONS
(At 1,000 ft. intervals)
PALO ALTO
PRINCIPAL MUNICPALITIES
N
SAN FRANCISCO BAY
DP - 31
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
50
DUMBARTON BRIDGE
LAUMEISTER TRACT
FABER TRACT
PALO ALTO PUMPING STATION
FLOOD BASIN

Figure I-1
BASIN PLAN ALTERNATIVE


ARTESIAN SLOUGH
SAN JOSE/SANTA CLARA PUMPING STATION
GUADALUPE RIVER
SARATOGA CREEK
GUADALUPE SLOUGH
SANTA CLARA – ALVISO ROAD
CALABAZAS CREEK
CARIBBEAN ROAD
SLOUGH
MOUNTAIN VIEW SLOUGH
SUNNYVALE PUMPING STATION
ALVISO FREEWAY
STEVENS CREEK
MOFFETT FIELD
BAYSHORE FREEWAY
SCALE IN MILES
COYOTE
ALVISO
SLOUGH
2
4
6
8
10
12
14
16
18
20
22
26
28
30
32
34
36
38
40
42
44
46
48

- Palo Alto
  - Los Altos
  - Los Altos Hills
  - Mountain View
  - East Palo Alto Sanitary District
  - Stanford University
  - Barron Park
  - Moffett Field
  - Las Encinas Sanitary District

The disposal of treated wastewater historically has been a serious problem confronting both the state water quality regulatory agencies and the wastewater discharge agencies within the San Francisco Bay watershed. The increase in pollutants and the attendant degradation in water quality in the Bay have been especially acute in the area of the Bay south of the Dumbarton Bridge because of its relatively low freshwater inflows and poor tidal dispersion. Within the last decade, strict water quality and effluent standards have been promulgated by the San Francisco Bay Regional Water Quality Control Board (SWRCB and RWQCB, 1974), the State Water Resources Control Board (SWRCB, 1974), and the Federal Government (Public Laws 92-500 and 95-217). These restrictions include the prohibition against discharge into the Bay south of the Dumbarton Bridge, achievement of a minimum of 10:1 dilution of wastewater at the discharge location, and a prohibition of discharge to any non-tidal or dead-end slough (SWRCB and RWQCB, 1975).

Disposal is not growth-related for this project (Section III.6). No increase in treatment plant capacity is planned, and, therefore, no secondary impacts on air quality will result from implementation of a disposal system in this critical air basin.

A disposal plan to protect the beneficial uses established in the Basin Plan (SWRCB and RWQCB, 1975) and to meet water quality standards proposed in that plan was set for the South Bay Dischargers Authority area (Figure I-1). It is this plan, hereinafter called the Basin Plan Alternative, which, together with its alternative disposal systems, is the subject of this draft EIR/EIS. Briefly, the Basin Plan requires that the South Bay Dischargers Authority (SBDA) construct a new conveyance and disposal system for discharge of treated wastewater in areas of minimal adverse environmental impact. Disposal north of the Dumbarton Bridge, where the tidal action will better disperse the discharge, was considered to provide the least environmental impacts.

I.1.2 BACKGROUND AND OBJECTIVES

Prior to the formation of the SBDA in 1973, an informal organization of its member cities, together with various other Bay Area dischargers, initiated a study to investigate alternative, long-term solutions to wastewater management problems in the South Bay area. A recommended plan was presented in a Consoer-Bechtel report entitled *Water Quality Management Plan for South San Francisco Bay* (March 1972). The recommended plan proposed in that report (hereinafter termed the South Bay Report) consisted of:

- Major subregional treatment plants providing advanced treatment at San Jose/Santa Clara, Palo Alto, and Newark (Union Sanitary District)
- Interceptor outfall systems
- Discharge through diffuser sections at a common disposal point in an area north of Dumbarton Bridge

A number of major technical and institutional changes occurred subsequent to completion of the South Bay Report that rendered the recommended system infeasible as it appeared in the report. Changes such as the following were incorporated into further feasibility studies:

- Sunnyvale's treatment of wastewater was continued.
- Union Sanitary District elected to participate in a regional program serving East Bay Dischargers Authority (EBDA).
- Menlo Park Sanitary District decided not to join the SBDA and elected to participate in the South Bayshore regional project.
- Milpitas joined with San Jose/Santa Clara for the treatment of its wastewater.

As a result of these developments, SBDA retained Bechtel Incorporated in 1973 to reevaluate all viable alternative water pollution control programs for the SBDA service area (including Sunnyvale as a discharger) for the planning period of 1975-1995.

The objectives and goals of this SBDA Water Pollution Control Program were to develop a wastewater management system that would:

- Meet receiving water quality standards, as reliably as possible, through 1985
- Be flexible enough to meet future, and possibly more stringent, standards beyond 1985
- Comply with present and possible future waste discharge requirements, effluent limitations, and discharge prohibitions
- Be as economical as possible within the above constraints
- Minimize adverse environmental impacts, mitigating to the extent possible those that cannot be avoided
- Maximize local and regional acceptability
- Retain the ability to accommodate local or regional wastewater reclamation and reuse, should such be implemented in the future.

This study culminated in the publication of the *Overview Facilities Management Plan* for SBDA (March 1974). In this study, a total of eight alternative water pollution control programs capable of serving the SBDA service area were examined. Several of this set of alternatives were dismissed from consideration on the basis of results obtained from a preliminary investigation. The remainder were subjected to a screening-level analysis based on the above stated objectives and their associated criteria. Following the screening-level analysis, three alternatives were selected for further detailed study, on the basis of which, the project described in Section I.2 was selected. This project has since been incorporated into the Basin Plan (SWRCB and RWQCB, 1975) and is called the Basin Plan Alternative in this EIR/EIS.

In May 1974, the State of California prohibited discharges south of Dumbarton Bridge, based primarily on the 1972 Consoer-Bechtel report and a concern for relative toxicity levels. This prohibition was supported by the 1974 Bechtel study for SBDA and was recommended formally in the Bays and Estuaries Policy of 1974.

In the summer of 1974, the Environmental Protection Agency and the State of California determined that the treatment program selected in the studies described above would be necessary regardless of disposal method and that the improvements in treatment did not require preparation of an EIS. Therefore, "negative declarations" were issued on the improvements to the water quality control plants. However, it was decided that disposal of the treated wastewater had potential for significant impacts that varied with the disposal system chosen. For this reason, the Environmental Protection Agency and SBDA undertook preparation of this Environmental Impact Report and Statement on the Basin Plan Alternative system and alternatives to it, assuming that the approved advanced waste treatment systems would be in operation. It should be noted that these systems are nearly complete but are not yet operating; they are scheduled for startup in late 1978.

I.1.3 CRITERIA FOR EVALUATION OF ALTERNATIVES

The criteria used to evaluate the engineering and the environmental impacts of the Basin Plan Alternative and the other candidate alternatives are based on both the quantifiable and nonquantifiable objectives and goals of the SBDA. The criteria can be categorized into four general areas of concern.

- Legal and Institutional Requirements (For a detailed discussion of these requirements see Appendix L.)
  - Conformance with waste discharge requirements as set forth in the Basin Plan and the Bays and Estuaries Policy of 1974
  - Compatibility with local planning goals
  - Conformance with the regionalization concept
  - Conformance with federal secondary treatment and best practicable treatment requirements
  - Acceptability of the program to local, regional, state, and federal agencies
- Comparative Cost
  - Present worth of total project costs
  - Initial capital costs
  - Operating and maintenance costs, including user charges
- Engineering
  - Reliability in meeting water quality standards
  - Reliability in treatment plant operation
  - Flexibility to meet more stringent water quality standards
  - Geotechnical considerations: adequate foundations and avoidance of fault zones
- Environmental Criteria
  - Avoidance of areas of biological significance, designated preserves, and refuges
  - Avoidance of areas of cultural or scientific value
  - Minimum construction and operational impact:
    - Biological
    - Physical/chemical
    - Aesthetic
    - Land use
  - Environmental enhancement
  - Resource conservation

I.1.4 EVALUATION OF ALTERNATIVES

The alternatives evaluated in this EIR/EIS can be categorized into eight disposal systems and a "no further action" alternative, as listed in Table I-1. All alternatives were evaluated based on the assumption that the developments approved for the principal treatment plants were, in fact, implemented: the San Jose/Santa Clara plant will possess a biological nitrification and filtration capability; Sunnyvale will have flotation, filtration, dechlorination, and biological nitrification capability; and the Palo Alto plant will be upgraded to accommodate biological nitrification and filtration. Sunnyvale's plant is undergoing startup operations in July 1978, while the other plants are scheduled for startup in late 1978.

Table I-1

ALTERNATIVES EVALUATED IN THIS EIR/EIS

Alternative Number	Mode of Disposal	Description
1	In Bay	Joint outfall pipeline connecting the three treatment plants, discharges to a point about one mile north of Dumbarton Bridge: The Basin Plan Alternative and its variants.
2	In Bay	Continue discharging locally. Complete advanced waste treatment facilities now planned or under construction at each of the existing treatment plants. Defer the disposal project or further treatment upgrading until the actual effect of these advanced treatment facilities on the South Bay can be observed: No Further Action.
3	In Bay	Conveyance of treated wastewater to deep water south of Dumbarton Bridge via individual pipelines: Individual Deepwater Discharge.
4	In Bay	Upgrade to provide highly advanced treatment at each treatment plant and continued discharge locally: Upgrade Treatment.
5	Rec/Reuse	Conveyance of all or a major portion of the treated wastewater to a reclamation/treatment plant. After further treatment, the reclaimed wastewater is transported to the reuse market: Reclamation/Reuse.
6	In Bay	Consolidation with other dischargers and conveyance of wastewater to a discharge point north of San Mateo Bridge: Consolidation.
7	Ocean	Pipeline and tunnel through the Santa Cruz Mountains, discharging in deep water in the Pacific Ocean: Ocean Discharge.
8	On Land	Pipeline, storage, and dispersal facilities for the spreading of wastewater on land. The dispersal precludes the requirement for upgraded treatment; the soil acts as an advanced treatment system: Land Disposal.
9	Nonstructural	Using phased development of treatment and disposal systems, in conjunction with source control, land-use planning, and environmental regulations, to regulate the quantity and quality of the wastewater: Nonstructural Wastewater Management.

The initial screening and subsequent analyses summarized below eliminated the less viable alternatives. A viable alternative is one which is technically feasible, economically competitive, or with similar or lesser environmental impacts. In other words, a viable alternative is a resonable alternative to be considered in making a decision on disposal systems for SBDA:

- Alternative 1. Discussed in detail in Section 1.2 as the Basin Plan Alternative, this is the alternative system described by the Consoer-Bechtel (1972) and Bechtel (1974) reports and proposed in the

Basin Plan (SWRCB and RWQCB, 1975) as meeting proposed water quality criteria, exception dissolved oxygen levels in the sloughs, being flexible enough to incorporate reclamation, and being cost-effective.

- Alternative 2. Although this violates the prohibition against discharges south of the Dumbarton Bridge and in non-tidal or dead-end sloughs, the minimum 10:1 dilution and the guideline for toxicity of 40 ml/l (relative toxicity), the cost attributable to no further action, in conjunction with similar dissolved oxygen concentrations in the sloughs and open water to the Basin Plan Alternative, render this a viable alternative.

- Alternative 3. This alternative does not comply with the SWRCB (1974) prohibition against discharge south of Dumbarton Bridge with minimum 10:1 dilution for all plants, or with relative toxicity guidelines, and it is not consistent with the concept of regional water pollution control. This project complies with dissolved oxygen criteria in open bay waters, however, and is compatible with local reclamation programs. This alternative is less costly than the recommended project and is a viable alternative.

- Alternative 4. This alternative does not comply with the SWRCB (1974) prohibition against discharge south of Dumbarton Bridge or to dead-end sloughs, the requirement for a minimum 10:1 dilution, or with relative toxicity guidelines. However, the potential for keeping a freshwater supply in the form of highly treated wastewater in the extremities of the Bay makes it a viable alternative.

- Alternative 5. This was considered viable since it provided for reclamation and reuse of a valuable natural resource in an area that imports a significant quantity of its water supply, although the cost of implementing this alternative may be prohibitive.

- Alternative 6. This requires consolidation with other discharger authorities in San Mateo County and discharge north of the San Mateo Bridge. Construction would be delayed for at least one year as a result of renewed negotiations on a joint-powers agreement. The increased capital costs render the system relatively less cost-effective because dissolved oxygen levels in the Bay would not be significantly increased. Abandonment of existing outfalls and planned programs in San Mateo County would be required. Environmental impacts during construction, particularly in the vicinity of the Greco Island and Bair Island units of the San Francisco Bay National Wildlife Refuge, would be relatively more disruptive to wildlife habitat than Alternative 1. This alternative is highly compatible with large-scale regional reclamation, but because of institutional and cost-effectiveness difficulties, this alternative was considered non-viable.

- Alternative 7. A pipeline would be constructed through the Santa Cruz Mountains for discharge into the Pacific Ocean. Although wastewater treatment requirements would be less than for other alternatives, anticipated problems with a major outfall crossing the San Andreas Fault, relative cost-ineffectiveness, significant construction impacts and incompatibility with large-scale regional reclamation caused this alternative to be considered non-viable.

- Alternative 8. The disposal of treated wastewater on land was dismissed on the basis of a U.S. Army Corps of Engineers (1974) study to locate an acceptable site at an elevation of 1,500 feet or less. No sites were identified in Santa Clara County that met all of the Corps' requirements for land disposal. Other sites in San Mateo and Santa Cruz Counties were found to be too small to handle SBDA flows. A site in Monterey County was found that could accommodate full flows forecast for the year 2000, but strong objections by Monterey County residents eliminated that site. Because no site could be found for disposal and because of cost-ineffectiveness, this alternative was not considered viable.

- Alternative 9. Nonstructural wastewater management uses phased development of treatment and disposal facilities to meet water quality criteria. This alternative entails source control, land-use planning, and enforcement of environmental regulations to control the quality and quantity of wastewater. The alternative modes of disposal discussed in this report were designed as part of the phased development of the SBDA wastewater management plan, which in turn was designed in response to source control, land-use, and environmental regulations. For this reason, nonstructural wastewater management is not an alternative mode of disposal; it is a criterion for disposal and has been incorporated as such into the disposal alternative systems.

Only a limited range of alternatives to the Basin Plan Alternative could feasibly attain the basic objectives and goals of the SBDA Water Pollution Control Program, although within this limited range there are numerous variations to individual system elements, routes, and alignments that could be considered. For purposes of the environmental analysis in this EIR/EIS, only five of the nine disposal alternatives warrant detailed description. The remainder of this section, therefore, focuses on the four viable alternatives to the Basin Plan Alternative: Alternatives 2, 3, 4, and 5. The Basin Plan Alternative is described in Section I.2, and detailed descriptions and analyses of all alternatives are presented in Section IV.

Alternative 2 — No Further Action

In this alternative, the secondary treatment facilities at the existing plants would continue in operation. In addition, the advanced treatment facilities presently planned or under construction would be in operation. These advanced facility improvements would include nitrification for removal of nitrogenous biological oxygen demand (BOD) and filtration for additional BOD removal. Disposal of treated effluents would continue at present locations (Figure I-2).

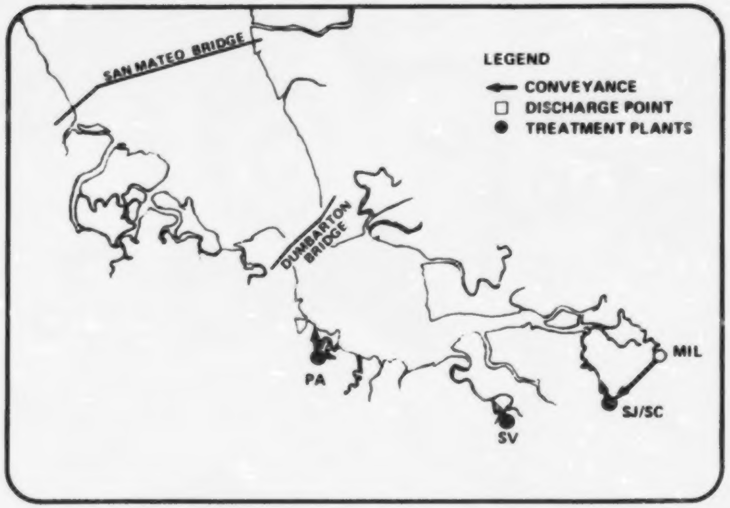


Figure I-2 SCHEMATIC – ALTERNATIVE 2

This alternative neither complies with the prohibition against continued discharge of treated wastewater south of Dumbarton Bridge or to dead-end sloughs, nor does it meet the minimum 10:1 dilution requirement. Moreover, a recent modeling study conducted by Hydroscience, Inc. shows that dissolved oxygen criteria cannot be met in the extremities of the Bay with this alternative (Appendix C). In addition, the model studies show continuing high levels of relative toxicity south of Dumbarton Bridge with this alternative. Discharges at the present disposal sites, however, would result in the continuation of freshwater flows (as highly treated wastewater) to Artesian Slough and would contribute to increased habitat diversity in Artesian Slough, an environmental benefit to the San Francisco Bay National Wildlife Refuge. This benefit could result in an exception to the discharge and dilution requirements for San Jose/Santa Clara. No such clear environmental benefit has been demonstrated for Palo Alto or Sunnyvale dischargers, however. Similarly, this benefit could be simulated by reclaiming some portion of the refuge area with a portion of San Jose/ Santa Clara effluent and utilizing an alternative disposal system.

This alternative may be viewed as a "delayed action" alternative, which allows an interim monitoring program and analysis of the effect of the approved treatment on the Bay environment. Should water quality be shown to improve markedly under this alternative, it may be determined that further action is not cost-effective. If, however, the rate of improvement were not satisfactory or if toxicity remains a problem, additional treatment or disposal methods could be implemented as needed.

Implementation of a conveyance or treatment system in the future would be subject to increased costs due to inflation; in addition, public support of future expanded systems in the form of state and federal grants may not be available. However, during this delayed action period, alternatives not now considered viable may be developed to a level of reliability, cost-effectiveness, and public acceptance that would allow their implementation.

Alternative 3 — Individual Outfalls to Nearest Deep Water

Using separate outfalls, each member discharger could, under Alternative 3, convey effluent to the nearest deep water south of the bridge (Figure I-3). This area has been described as ecologically sensitive with a potentially high risk for adverse impact (SWRCB, 1975). Palo Alto would discharge at a point offshore of the Palo Alto Yacht Harbor, while Sunnyvale and San Jose/ Santa Clara would convey their effluents to a discharge near Calaveras Point. This system is technically feasible in that it would meet dissolved oxygen requirements in Bay waters and would discontinue discharge of oxygen demanding and toxic materials from point sources to the sloughs (Hydroscience, Appendix C), although it does not meet the prohibition against discharge south of Dumbarton Bridge.

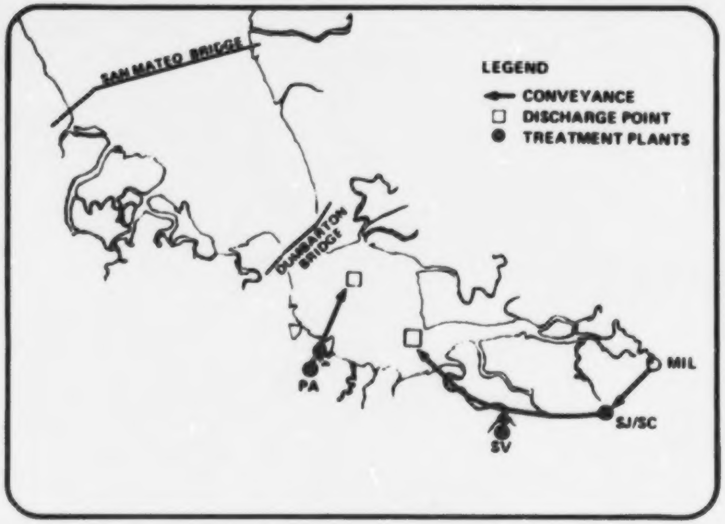


Figure I-3 SCHEMATIC – ALTERNATIVE 3

However, improvement in water quality in the South Bay would not be as great as with complete removal of the wastewaters from south of the bridge. In addition, the flushing of Artesian Slough with "fresh water" would cease, resulting in a loss of freshwater habitat and a rise in expression of existing natural background oxygen demand in the sloughs. As for the Basin Plan Alternative, this slough would become a tidal slough, which would not reach 5 mg/l dissolved oxygen in some portions of the slough during the dry season and the canning season. In addition, toxicity levels would remain high in the South Bay, although estimated to be one-fourth those of no action (Alternative 2).

This alternative system is not a regional system and would have to be abandoned should large-scale centralized reclamation be implemented or should monitoring of water quality indicate that disposal north of Dumbarton Straits was indeed necessary. However, these outfalls would be usable as winter outfalls and as partial summer outfalls for local, seasonal reclamation programs.

This alternative would not require the construction of the Basin Plan conveyance system, eliminating the impacts that would accompany dry land construction. However, construction of individual conveyances would result in aquatic impacts similar in type, but greater in extent, than those expected from the larger Basin Plan Alternative. These impacts would be localized, short-term, and reversible and would consist primarily of increased turbidity and suspension of sediments at dredge sites and at the spoils disposal site, disruption of estuarine mud flat communities along the Sunnyvale-San Jose/Santa Clara conveyance, impact on the tidal flat communities along the Palo Alto conveyance, and noise, dust, and limited access along the terrestrial portions of the routes. Depending on the exact alignments, portions of marshlands, dikes, and salt evaporators in and near the San Francisco Bay National Wildlife Refuge would also be disturbed.

The cost of construction of these deepwater outfalls would be approximately 80 percent of that for the Basin Plan Alternative, or $69 million. No estimates for operation and maintenance have been made; however, the costs should not differ significantly from the $321,000 annual costs of the Basin Plan Alternative.

Alternative 4 — Local Discharge with Upgraded Treatment

This alternative differs from the Basin Plan Alternative in that no new effluent conveyance and disposal facilities would be constructed. Instead, an upgrading in the degree of treatment would be provided at the San Jose/Santa Clara water pollution control plant. The increase in treatment would be greater than the levels currently proposed or under construction for each plant. Upon implementation of this alternative, the SBDA member cities would continue to discharge at their present points of discharge as shown in Figure I-4, i.e., the San Jose/Santa Clara plant discharges into the headwaters of Artesian Slough, Sunnyvale discharges into Guadalupe Slough, and Palo Alto into a dredged channel north of the Palo Alto Airport.

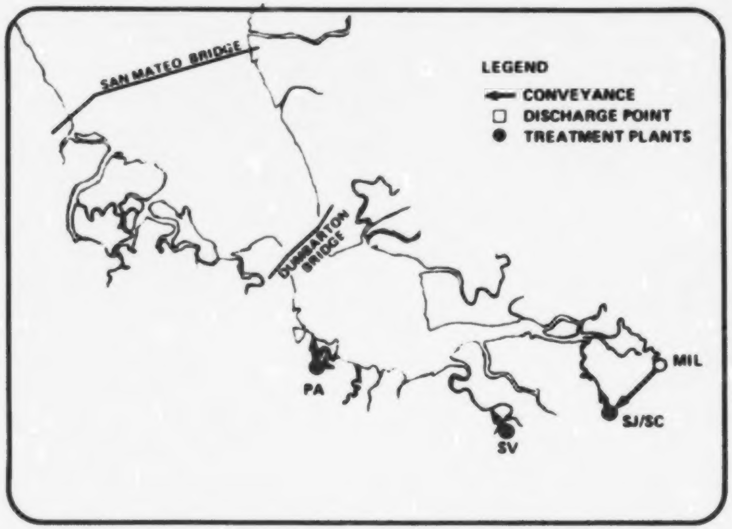


Figure I-4 SCHEMATIC – ALTERNATIVE 4

The advanced treatment discharge by San Jose/Santa Clara at Artesian Slough could enhance freshwater habitats in the slough, if the water quality objective of 5.0 milligrams per liter (mg/l) for dissolved oxygen in receiving waters, as required by the *Water Quality Control Plan, San Francisco Bay Basin* (i.e., the Basin Plan, SWRCB and RWQCB, 1975), could reliably be maintained, and if effective source control or pretreatment of toxicants could be implemented. This freshwater habitat would continue to contribute to the diversity in the

Alviso unit of the San Francisco Bay National Wildlife Refuge, establishing an area suitable for waterbird breeding and for other wildlife that require a source of fresh water not now common in the South and Central Bays. (Discontinuation of wastewater discharge at Artesian Slough would result in the reversion of the area to a saline slough. This slough may not be subject to fluctuating dissolved oxygen concentrations and toxic components from the wastewater, but the lack of a freshwater marsh in the area would result in decreased habitat diversity in the National Wildlife Refuge.)

Additional treatment processes to be implemented at the San Jose/Santa Clara plant under this alternative would be those necessary in order to meet the Basin Plan water quality objective of 5.0 mg/l dissolved oxygen. The processes, including residual ammonia removal through breakpoint chlorination, and adsorption on activated carbon for further reduction of oxygen demanding substances and toxicants, would supplement existing primary and secondary treatment and proposed biological nitrification and filtration (Bechtel, 1974).

Provision of this upgraded treatment to the anticipated 1985 flow of 143 mgd would result in a calculated discharge of oxygen demand to Artesian Slough of 11,000 pounds per day (Bechtel, 1974).

At Sunnyvale and Palo Alto, Bechtel (1974) assumed that acceptable water quality (i.e., 5 mg/l DO concentrations, relative toxicity near the 40 ml/l guideline and at least 10:1 dilution of the wastewater) could be met with currently approved levels of treatment. Therefore, if more advanced treatment were implemented at San Jose/Santa Clara, no additional upgrading would be required at Palo Alto or Sunnyvale.

Although wastewater discharge would not be removed from south of the Dumbarton Bridge or from dead-end sloughs and the minimum 10:1 dilution would not be attained, water quality in the South Bay could be expected to improve. The rate and the location of the improvement, though, would be different from that expected for the Basin Plan Alternative. The discharge of high quality fresh water would encourage the establishment of fresh water habitats rather than saltwater communities in Artesian Slough. Maintaining and enhancing such fresh water habitats is of particular interest to the U.S. Fish and Wildlife Service, which administers the San Francisco Bay National Wildlife Refuge. These fresh water habitats provide feeding grounds for numerous terrestrial and marshland species of animals and are necessary for the survival of young waterfowl such as ducks. These animals require a source of good quality fresh water, and establishing populations of these animals in proximity to the wildlife refuge increases the recreational and ecological value of this area.

Any breakdown in the treatment plants that requires a bypass and discharge of partially treated or untreated effluent to the Bay could have serious, short-term impacts on the local Bay water quality and biota. Such bypasses could subject newly established and sensitive species to stresses, resulting in fish kills or contamination of shellfish beds. The impact of these stresses would be more severe on a biological community established in an improving Bay system than on current "pollution tolerant" Bay fauna.

The reliability of upgraded treatment in providing high quality fresh water for a healthy marsh system is dependent in part on the ability of the system to meet the water quality criteria. Bechtel (1974) concluded that, even with upgraded treatment, discharge from the San Jose/Santa Clara plant into Artesian Slough may not permit maintenance of 5.0 mg/l dissolved oxygen in all reaches of the slough. In addition, the continued discharge of biostimulants and toxicants, and the potential increase in these substances, could negate the potential benefits of an increased dissolved oxygen concentration in Artesian Slough. These conclusions were verified by the refined Hydroscience model for the South Bay (Appendix C), and the ability of presently approved treatment at Palo Alto and Sunnyvale to meet dissolved oxygen requirements was also called into doubt by the Hydro-science model runs.

The estimated annualized capital cost over 20 years of the upgraded treatment would be approximately 135 percent of that of the Basin Plan Alternative, or $116 million. Operation costs would be greater than present treatment plant costs due to increased consumption of chemicals and energy.

Alternative 5 — Reclamation and Reuse of Treated Wastewater

In view of the stated policies of the State of California (SWRCB, 1974 and SWRCB, 1977) and the U.S. EPA (1975) in favor of reclaiming wastewater for reuse where feasible (see Appendix L), primary consideration was given to the wastewater disposal system alternatives that offered the greatest degree of flexibility for the implementation of wastewater reclamation. Elimination of direct discharge of wastewater in favor of reclamation would achieve the 1985 goal of zero discharge of pollutants required in the Federal Water Pollution Control Act of 1972 and the Clean Water Act of 1977. Unlike Alternative 4, this alternative is similar to the Basin Plan Alternative in that new effluent conveyance and disposal facilities would be designed and constructed to accommodate reversible flow with discharge north of Dumbarton Bridge (see Figure I-5).

In all other alternatives examined, reclamation and reuse can be utilized as a viable option in either the near or long term; however, with Alternative 5, reclamation and reuse of the total effluent flows were assumed to be immediate goals.

The Consoer-Bechtel (1973) review of alternative reclamation programs similar to the one described in Figure I-5 (see Table I-2) and of potential markets for reclaimed water determined that the feasibility of any reclamation and reuse alternative to the proposed project depends on whether or not the San Felipe Water Distribution Project is implemented.

The San Felipe Water Distribution Project is sponsored by the U.S. Bureau of Reclamation for the purpose of transporting water from the Bay Delta to Santa Clara Valley. The Consoer-Bechtel report concluded that the market was not large enough for both reclamation and for the 273,000-acre-foot capacity San Felipe Project; the construction of one "virtually eliminates the need for the other." Recent studies (Section V) have shown that, from the standpoint of agricultural use, water obtained from these two sources is not interchangeable in terms of quality and may not be interchangeable in terms of cost. For this reason, implementation of a reclamation project does not necessarily eliminate the "need" for imported water for some uses.

The major benefit of reclamation and reuse is reduced diversions from the Bay-Delta. In "water-short" areas (i.e., areas that must import water to meet demand) such as the San Francisco Bay Area, the costs of developing new water supplies are continually rising. Treatment of wastewater and implementation of a reuse

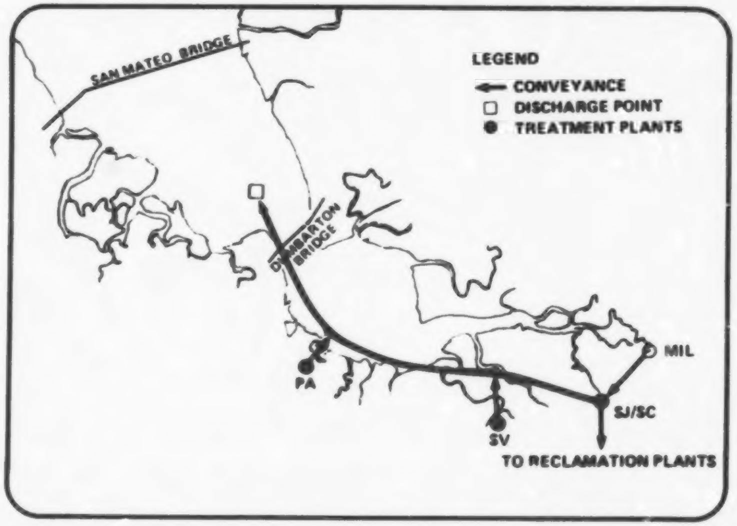


Figure I-5 SCHEMATIC – ALTERNATIVE 5

program may release water supplies of sufficient quality to meet the demands of Santa Clara County without increasing diversions from the Bay-Delta.

Table I-2

RECLAMATION ALTERNATIVES
EVALUATED BY CONSOER-BECHTEL (1973)

1A[*]	Reclaimed water from Palo Alto, San Jose/Santa Clara, and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County and surface irrigation in south county.
1B	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County and surface irrigation in south county.
2	Reclaimed water from Palo Alto and reclamation plants located "up sewer" to be used for percolation in north Santa Clara County.
3	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for injection in north Santa Clara County and surface irrigation in south county.
4A	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County and in Coyote Basin.
4B	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for injection in north Santa Clara County and percolation in Coyote Basin.
5A	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County and Coyote Basin; San Felipe Project implemented for south county.
5B	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County; San Felipe Project implemented for south county.
5C	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for injection in north Santa Clara County; San Felipe Project implemented for south county.

[*] Consoer-Bechtel Alternative Number.

Notwithstanding these and other benefits, reclamation and reuse have a number of disadvantages. These include:

- The cost of treatment. Reclamation plants treat wastewater to a higher degree than is usually required to meet water pollution control standards. This level of treatment consumes larger quantities of energy and chemicals with only small increments in improvement of water quality. These costs when coupled with the cost of conveyance and pumping are reflected in higher user charges to consumers of reclaimed water or in higher subsidies of treatment by the taxpayer.

- The limits of treatment. A number of chemical constituents of wastewater do not break down or decay during the treatment process but are discharged in treated effluent (conservative elements). Many of these materials may accumulate in natural systems. Nitrates, dissolved salts, and heavy metals are elements that require costly methods of treatment in order to reduce the concentrations in reclaimed water to levels acceptable to public health agencies and consumers. In some instances, treatment to acceptable levels is technically and economically feasible; in others, where quantities of these elements are particularly high, treatment is not economically feasible.

- The impacts of reuse. Nitrates, dissolved salts, trace organic materials, and viruses may build up in groundwater supplies recharged with reclaimed water. Body contact recreation and consumption of fish and shellfish may be restricted in bodies of water receiving supplemental flows from reclaimed water. Certain crop species are sensitive to elements such as boron in reclaimed water and cannot be irrigated with it; other crops such as leafy vegetables may not be irrigated with reclaimed water and sold for human consumption because of the potential for bacterial or viral contamination.

- The problem of public acceptance. Even in instances where wastewater reclamation is economically and technically feasible, the general public has not been inclined to accept reclamation as a general practice. However, the Corps of Engineers (personal communication, 1975) has found that the public, in general, has a positive attitude toward reclamation for industrial reuse or landscape irrigation.

In order for reclaimed water to meet health requirements and other constraints, it must be treated for total dissolved solids (TDS), nitrates, viruses, and pathogenic bacteria. Any failure in the treatment system would result in a potential hazard to public health. For this reason, provisions for bypasses and their disposal, as well as provisions for disposal of wet weather flows must be incorporated into the plant design. Consequently, the construction of a reclamation-reuse project for SBDA's wastewater would have construction impacts on the South San Francisco Bay environment equivalent to those expected for other project alternatives unless storage reservoirs prove to be cost-effective. Impacts on water quality, biota, and area residentts would be similar to those projected for the Basin Plan Alternative — short-term, local, and reversible.

Additional impacts would result from the construction of a regional conveyance system for transport of reclaimed water to the reuse markets. These impacts would vary somewhat with the choice of market and conveyance, but would all be related to clearing and grading of a right-of-way, trenching and backfilling, crossing streams or roads, and working near residences and other built-up areas.

With reclamation and reuse, the discharge of wastewater to the Bay in the dry (summer) season could be decreased by between 67 and 143 mgd (Consoer-Bechtel, 1973; Bechtel, 1974). The improvement in Bay water quality would be proportional to the decrease if no additional treatment were initiated. However, the effect of decreased flows on the freshwater habitats would be similar to those described above for Alternative 4. If the treatment procedures necessary to make reclamation acceptable to the public were implemented for all effluent flows, depending on the relative volumes of disposed and reclaimed water, water quality of San Francisco Bay might be expected to improve at an increased rate.

Operation of treatment facilities capable of reclamation would result in an increase in the consumption of chemicals and energy over that currently projected for the plants. This increase would be reflected in increased operating costs. The costs of improved treatment for reclamation and a conveyance system would be added to the costs for a backup disposal system to the Bay. The estimate for the annualized capital costs of Alternative 5 over 20 years is approximately 379 percent of that associated with the Basin Plan Alternative, or $326 million. It is anticipated that a portion of this cost could be offset by the sale of water to the Santa Clara Valley Water District and other markets.

I.1.5 ALTERNATIVE ALIGNMENTS TO BASIN PLAN ALTERNATIVE

It is important to examine alternative routes of the Basin Plan Alternative system to determine the most desirable alignment for a joint outfall pipeline. In the previous feasibility study (Bechtel, 1974), several routes were examined in detail with the objective of recommending to SBDA one land route and one estuarine (water) route. The estuarine route is shown in Figure I-6. The land route is described in detail in Section I.2 as part of the Basin Plan Alternative.

The estuarine alignment parallels the Basin Plan Alternative system land route to a point north of the Sunnyvale water pollution control plant. It then leads to a main navigation channel in the Bay in the vicinity of Calaveras Point and follows the channel northwest to the disposal area. A connecting line would be provided from the Palo Alto treatment plant to the main outfall pipeline.

LEGEND:

——— ON-LAND PORTION OF ESTUARINE ALIGNMENT

··—·—·— ON-WATER PORTION OF ESTUARINE ALIGNMENT

—+—+— ON-LAND ALIGNMENT

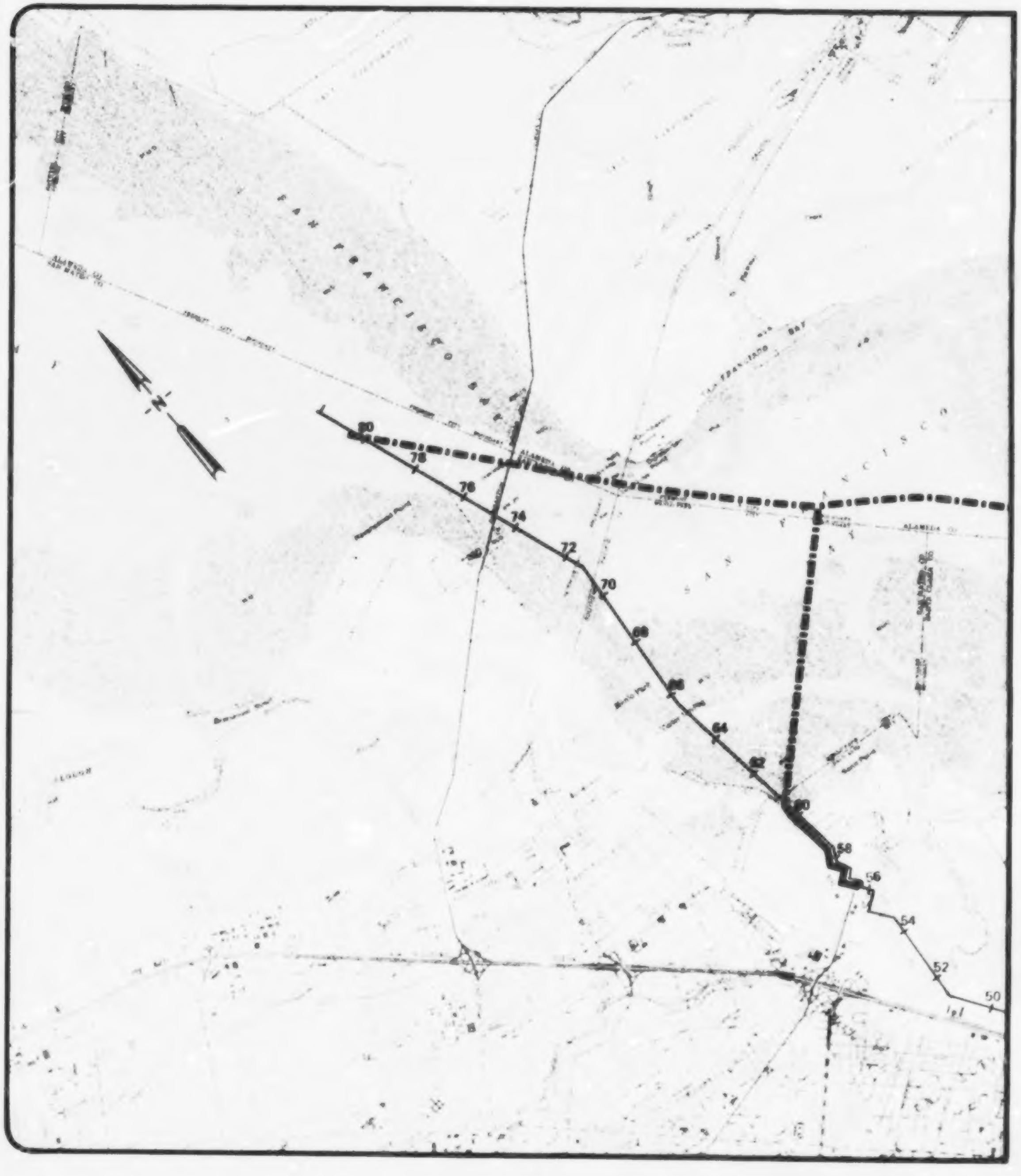
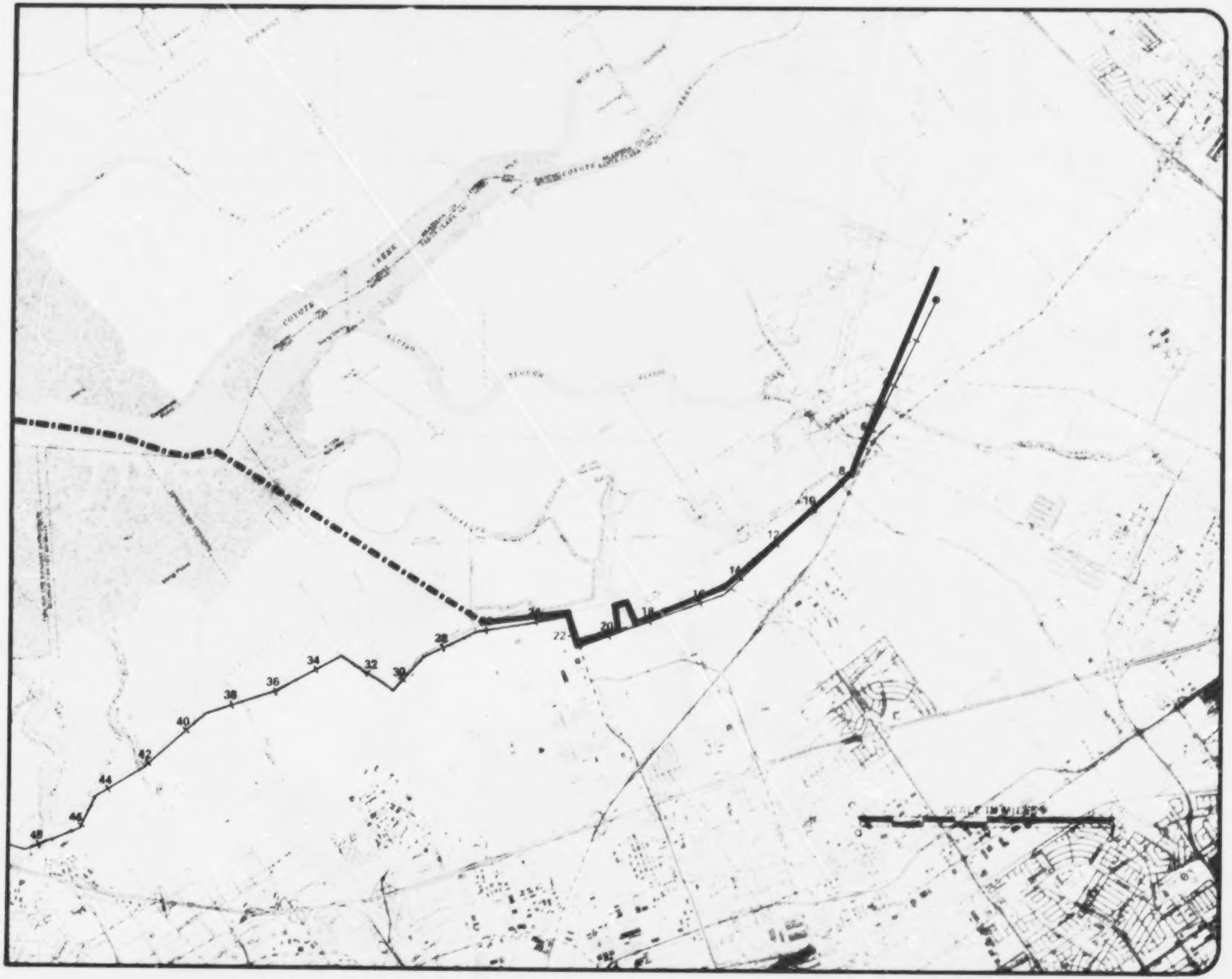

N
SAN FRANCISCO BAY
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
50

Figure I-6
ALTERNATIVE ALIGNMENTS



COYOTE
CREEK
SLOUGH
8
10
12
14
16
18
20
22
24
28
30
32
34
36
38
40
42
44
46
48
SCALE IN MILES

The route is approximately 14 miles long, with a 3-mile-long connector from Palo Alto. Construction along much of the route would require the use of deep-draft pipeline barges, in addition to on-land crews. The limited availability and cost of the necessary barge equipment would probably make the use of more than one barge uneconomical. The construction time for completion of this project, therefore, would be as much as three months longer than for the land route.

Environmental impacts associated with the land route include the disturbance of the salt marsh along the right-of-way in the vicinity of the Palo Alto Baylands Reserve and disruption of mud flat and open water biological communities in the underwater portion of the alignment. The estuarine alignment, however, would also affect the salt marsh habitat at the salt pond levees near Devil's Slough, as well as the salt ponds and levees themselves. Other estuarine impacts would include disruption of a mud flat community in the southern portion of the Bay, as well as impacts on open water communities. These impacts would be short-term, lasting as long as construction activity, and would be partially mitigated through marsh revegetation, restoration of salt evaporator surfaces, and the use of clean backfill in the excavated trench.

Preliminary estimates of the cost for construction of the estuarine alternative (including right-of-way costs) are only slightly higher than the cost of the Basin Plan Alternative on-land alignment. However, a number of uncertainties are associated with the construction cost estimate for the estuarine route, i.e., the availability of barge equipment and the costs for construction in salt ponds while maintaining levee integrity. The restoration of bottom surfaces in the ponds and the added time necessary for construction are further costs.

The estuarine alignment would not be as adaptable to a future regional reclamation and reuse project as the land alignment, because connection to a new conveyance coming southward down the San Francisco Peninsula would be much more difficult. Also, maintenance and repair of an underwater pipeline would be more difficult than for a land conveyance.

I.2

THE BASIN PLAN ALTERNATIVE

I.2.1 LOCATION

As shown in Figure I-7, the Basin Plan conveyance pipeline and associated connecting lines and pumping facilities would be located along the southwestern shore of the South San Francisco Bay. The pipeline would start at the San Jose/Santa Clara water pollution control plant, proceed through system pumping stations at Sunnyvale and Palo Alto, and terminate at a diffuser in the deepwater channel north of the Dumbarton Bridge. For the purposes of this impact analysis, the Basin Plan Alternative can be separated into seven individual elements. Each individual element and its specific location is described in Section I.2.2. According to direction and sequence of flow, the seven elments are:

(1) San Jose/Santa Clara pumping station

(2) Pipeline from the San Jose/Santa Clara pumping station to the existing Sunnyvale treatment plant

(3) Sunnyvale pumping station

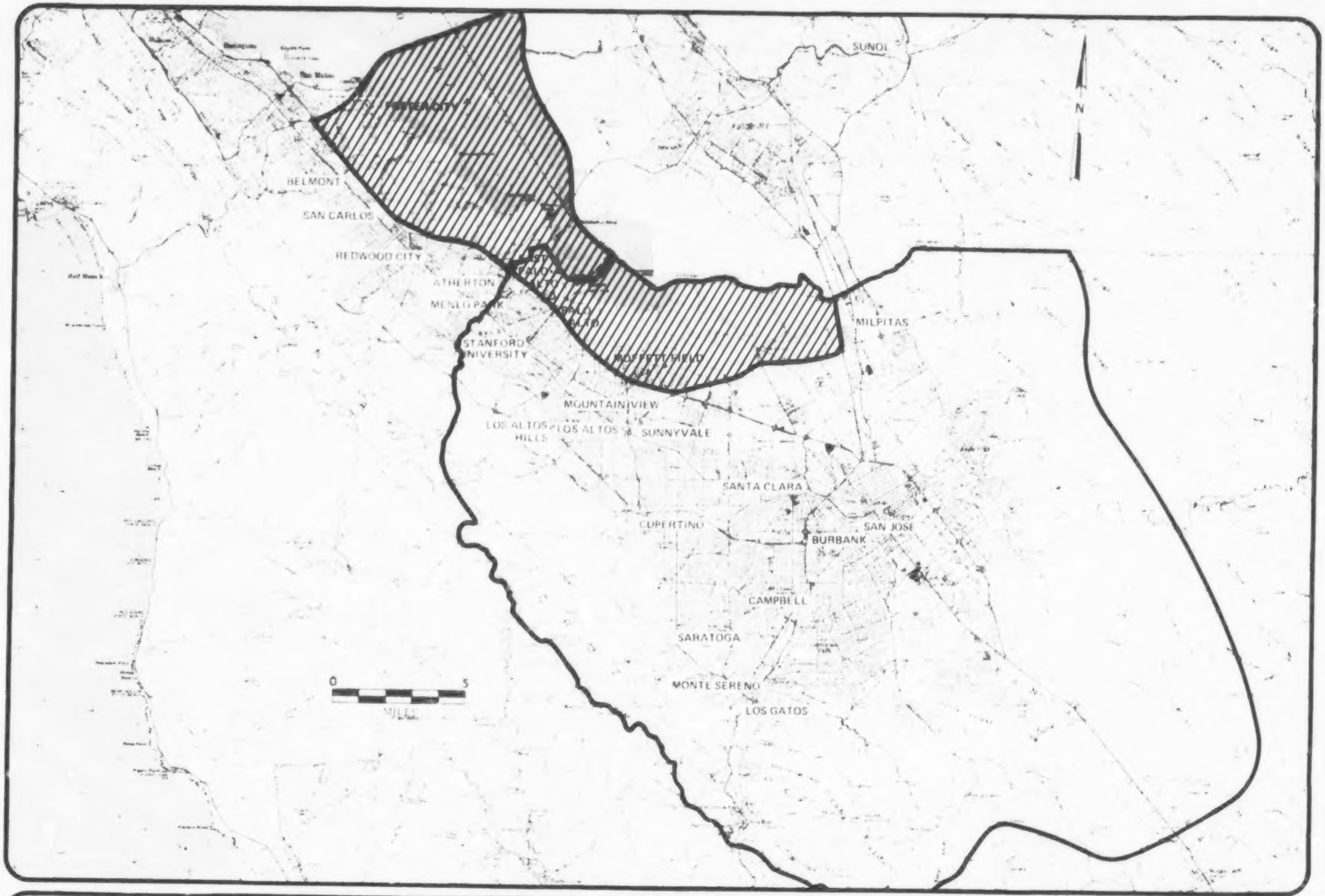
(4) Pipeline from Sunnyvale to the existing Palo Alto treatment plant

(5) Palo Alto pumping station

(6) Pipeline from Palo Alto to the discharge point in the Bay

(7) Diffuser equipment at the end of the pipeline

The current pipeline design does not include capability for reversing the direction of flow. It could be made reversible without a major cost increase, however, in order to transport flows from other peninsula dischargers to sites outside the Bay Area for reclamation and reuse. These could include the San Francisco southeast plant and the San Mateo County dischargers, currently disposing into the San Francisco Bay.


SUNOL
N
FOSTER CITY
BELMONT
SAN CARLOS
REDWOOD CITY
ATHERTON
MENLO PARK
STANFORD UNIVERSITY
PALO ALTO
MOFFETT FIELD
MILPITAS
MOUNTAIN VIEW
LOS ALTOS HILLS
LOS ALTOS
SUNNYVALE
SANTA CLARA
CUPERTINO
SAN JOSE
BURBANK
CAMPBELL
SARATOGA
MONTE SERENO
LOS GATOS
0
5
MILES

□ SBDA SERVICE AREA

▨ APPROXIMATE BOUNDARY OF BASIN PLAN ALTERNATIVE STUDY AREA

Figure I-7
STUDY AREA LOCATION
AND PRINCIPAL MUNICIPALITIES

I.2.2 FACILITIES FOR THE BASIN PLAN ALTERNATIVE

The design flows used for sizing the pipeline system and pumping stations were established to accommodate anticipated 1995 E-zero populations plus canning season flows (Bechtel, 1974). Under the regulations of the State Water Resources Control Board, as amended August 16, 1973, an outfall facility in the area indicated in Figure I-7 would be eligible for funding under the Clean Water Grant Program only to the extent that it provides capacity to accommodate a 20-year growth in population according to the State Department of Finance E-zero population projections in effect at the time of funding by state and federal agencies (SWRCB, 1978) (see Section II.1.3 for population projections based on an E-zero growth rate – replacement birth rate and no immigration). The E-zero rate was used as the basis of forecasts for projects located in critical air basins.

In the Bechtel (1974) report, it was assumed that the project construction would commence in 1975, and design flows were therefore based on a 20-year projection to 1995. Average daily flows were determined using the population projections distributed to each treatment plant service area and the daily per-capita flows. The flows, adjusted to peak flows, are shown in Table I-3. New population predictions would be made for 10- and 20-year intervals in the final design phase to account for revision of the construction schedule.

As shown in Figure I-7 most of the Basin Plan pipeline alignment lies along the shoreline of Santa Clara County. The pipeline system would be approximately 16 miles in length, buried for its entire length, and would have appropriate pumping, emergency bypass, and control facilities. The pipeline inside diameter would be 90 inches for the first segment, 96 inches for the second segment, and 102 inches for the last segment. The pipe would be concrete or steel. Material selection would be included in final design; contractors would be allowed to bid on either alternative based upon final design specifications. Concrete pipe would be plain reinforced in lower pressure classes and prestressed in higher classes (above 100 to 150 feet of operating head). Steel pipe would be mortar-lined and coal tar coated. Externally-impressed cathodic protection would be provided. Where the thickness of soft Bay Mud is greater than 20 feet, pile support systems would be provided. The trench would be approximately 14 to 18 feet deep and 60 to 110 feet wide at the top, depending on soil conditions.

Table I-3

BASIN PLAN ALTERNATIVE DESIGN CRITERIA, 1995

	Flow (mgd)	Design Quality (mg/l)		
		BOD_5	SS	NH_3-N
San Jose/Santa Clara	279	10	5	1.5
Sunnyvale	30	5	2	4
Palo Alto	68.6	12	10	5.4

Note: Design quality based on approved upgrading
BOD_5 = five-day biological oxygen demand
SS = suspended solids
NH_3-N = ammonia nitrogen (as nitrogen)
mgd = million gallons per day

Pumping stations would be based on a relift system, where the flow from the previous plant would be discharged into a sump. The vertical turbine pumps would lift the combined effluent of the individual plant plus the plant(s) already discharging into the pipeline. Pumping units would be designed to operate under a wide range of flow conditions, taking into account variations between minimum flow conditions, average daily flows, and wet weather peak flows. Consequently, it would not be necessary to have more than one standby pumping unit available for each pumping station under normal operating conditions. However, recent long lead times [illegible] repair or purchase of major equipment items suggest that purchase of additional standby equipment be considered in the final design.

A flow meter and provision for equipment to obtain water quality samples would be installed at the downstream end of the discharge manifold at each pumping station. Control of the pump units would be through control panels at each treatment plant, with water level probes in the sump automatically actuating pumping operations.

Power for each pumping station would be supplied by two 12-kilovolt lines, where possible, from the local utility or supplier. Pipeline bypass facilities would be available at each treatment plant, should it be necessary to shut down the outfall pipeline or pumping stations for emergency repairs and/or maintenance.

Pipeline sizes were selected to minimize total cost, including the cost of pipe, pumping stations, and energy consumption.

The estimated capital cost of the project, in 1980 dollars, is $86,123,000. The yearly cost, based on a 1980 operation and management estimate and using a 7-percent interest rate, would be approximately $3,241,000 ($321,000 operating and management and $2,920,000 annualized capital costs).

San Jose/Santa Clara Pumping Station

A conceptual pumping station layout for the San Jose/ Santa Clara treatment plant is shown in Figure I-8. The system would be an outdoor station with pumps drawing from a sump and discharging into a manifold. The sump capacity of approximately 750,000 gallons is based on a 15-minute pumping volume of one large pump. As shown in Table I-4, one set of pumps with a capacity of 36,000 gallons per minute (gpm) is intended to operate in the range of minimum to 1.4 times the average daily flow. The other set of pumps would handle peak flows of 50,000 gpm. Standby units for normal flows would also be provided. In addition, an emergency bypass to Artesian Slough (the present discharge point) would be provided in the event of pumping station breakdown or system failure further up the pipeline, which would require SBDA to bypass a common conveyance.

Table I-4

SAN JOSE/SANTA CLARA PUMPING STATION CHARACTERISTICS(1)

Specification	Season	
	Dry	Wet
Pump capacity (gpm)	40,000	45,000
Horsepower	300	1,050
No. of units		
Service	3	5
Standby	1	0
Approximate sump capacity (gal)(2)	750,000	750,000

Notes: (1) Based on the "relift system"
(2) Based on 15-minute pumping volume of one large pump

Pipeline Segment — San Jose/Santa Clara to Sunnyvale

The first segment of the pipeline (Figure I-7) would start at the San Jose/Santa Clara water pollution control plant, crossing open fields near the existing City of Santa Clara raw sewage force main leading to the treatment plant. After crossing Alviso Slough, the pipeline would turn slightly, avoiding an existing landfill, and cross Alviso Road and the Southern Pacific Railroad. In open fields east of Caribbean Road, the pipeline would be adjacent to an existing 30-inch diameter high pressure natural gas pipeline. After crossing Caribbean Road, the pipeline would follow the northern edge of Moffett Industrial Park to the Sunnyvale pumping station.

Sunnyvale Pumping Station

The tentative location of the Sunnyvale pumping station is shown in Figure I-9. The design, control systems, power supply, and emergency bypass (to Guadalupe Slough)

CONTENTS

Section Page

I DESCRIPTION OF BASIN PLAN AND ALTERNATIVES
I.1 DESCRIPTION OF ALTERNATIVES 1 1/D13
I.1.1 Introduction 1 1/D13
I.1.2 Background and Objectives 4 1/E5
I.1.3 Criteria for Evaluation of Alternatives 6 1/E9
I.1.4 Evaluation of Alternatives 6 1/E9
Alternative 2 — No Further Action 9 1/F1
Alternative 3 — Individual Outfalls to Nearest Deepwater 10 1/F3
Alternative 4 — Local Discharge with Upgraded Treatment 11 1/F5
Alternative 5 — Reclamation and Reuse of Treated Wastewater 13 1/F9
I.1.5 Alternative Alignments to Basin Plan Alternative 15 1/F13
I.2 THE BASIN PLAN ALTERNATIVE 19 1/G7
I.2.1 Location 19 1/G7
I.2.2 Facilities for the Basin Plan Alternative 21 1/G11
San Jose/Santa Clara Pumping Station 22 1/G13
Pipeline Segment — San Jose Santa Clara to Sunnyvale 22 1/G13
Sunnyvale Pumping Station 22 1/G13
Pipeline Segment — Sunnyvale to Palo Alto 24 2/B1
Palo Alto Pumping Station 24 2/B1
Pipeline Segment — Palo Alto to Discharge Point 24 2/B1
Diffuser 24 2/B1
I.2.3 Construction of the Basin Plan Alternative 25 2/B3
Construction Procedures on Land 25 2/B3
Construction Procedures in Water 26 2/B5
I.2.4 Operation of the Basin Plan Alternative 28 2/B9
I.3 APPROVALS REQUIRED 29 2/B11
II ENVIRONMENTAL DESCRIPTION
II.1 PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT) 31 2/C3
II.1.1 Physical Environment 31 2/C3
Topography 31 2/C3
Geology and Seismology 33 2/C7
Groundwater 33 2/C7
Soils 36 2/C13
Sediments 37 2/D1
Meteorology 39 2/D5
Air Quality 40 2/D7
— The Air Pollution Problem in the Bay Area 40 2/D7
— Emissions and Air Quality 40 2/D7
— Air Quality in the Bay Area 45 2/E3
— Air Impacts of Wastewater Disposal 45 2/E3
Hydrology 45 2/E3
— Tides and Currents 46 2/E5
— Circulation and Dispersion 47 2/E7
Water Quality 49 2/E11
— Temperature 51 2/F1
— Transparency 51 2/F1
— pH 51 2/F1
— Suspended Solids 51 2/F1
— Salinity 52 2/F3
— Dissolved Oxygen and Oxygen Demand 53 2/F5
— Nutrients 53 2/F5
— Chlorophyll 54 2/F7
— Coliform Bacteria 54 2/F7
— Oil and Grease 55 2/F9
— Toxicity 55 2/F9
— Heavy Metals 57 2/F13
Noise 57 2/F13
II.1.2 Biological Environment 58 2/G1
South Bay Habitats 58 2/G1
— Open Water 61 2/G7
— Tidal Mud Flats 64 2/G13
— Salt Marsh 68 3/B5
— Salt Ponds 71 3/B11
Dikes and Levees 74 3/C3
— Grasslands 75 3/C5
— Streams and Sloughs 75 3/C5
— Freshwater Marshes and Ponds 77 3/C9
Species of Special Concern 78 3/C11

II.1.3 Social, Economic, and Cultural Environment 83 3/D7
Population and Demography 83 3/D7
Recreational and Scientific Uses of the Area 87 3/E1
Archaeological, Paleontological, Historical and Cultural Resources 88 3/E3
— Archaeological Resources 88 3/E3
— Paleontological Resources 89 3/E5
— Historical and Cultural Resources 89 3/E5
Visual and Aesthetic Setting 93 3/E13
Economic Setting 98 3/F9
II.2 LAND USE
II.2.1 Present Land-Use Patterns 101 3/G1
Existing Land Use 101 3/G1
— Santa Clara County 101 3/G1
— San Mateo County 104 3/G7
Existing Public and Private Developments 104 3/G7
Mineral Resources of the Baylands 112 4/B7
II.2.2 Projected Land-Use Patterns 112 4/B7
Planned Public and Private Developments 112 4/B7
Land-Use Plans and Planning Agencies 114 4/B11
Interested Agencies 118 4/C5
— Local 118 4/C5
— Regional 118 4/C5
— State 118 4/C5
— Federal 119 4/C7
II.3 WATER USE
II.3.1 Existing and Proposed Wastewater Treatment Facilities 120 4/C9
San Jose/Santa Clara Regional Water Pollution Control Plant 120 4/C9
Sunnyvale Water Pollution Control Plant 120 4/C9
Palo Alto Treatment Plant 121 4/C11
Menlo Park Sanitary District Wastewater Treatment Plant 121 4/C11
Redwood City Sanitary District — Redwood City Sewage Treatment Facility 121 4/C11
Redwood City Sanitary District — Redwood Shores Plant 122 4/C13
Belmont/San Carlos Joint Sewage Treatment Facility 122 4/C13
Proposed Redwood Shores Subregional Plant 122 4/C13
Union Sanitary District — Alvarado, Plant No. 3 122 4/C13
Union Sanitary District — Newark, Plant No. 1 122 4/C13
Union Sanitary District — Irvington, Plant No. 2 122 4/C13
II.3.2 Current and Projected Sources of Water 122 4/C13
II.3.3 Current Water Use and Projected Demand 123 4/D1
II.3.4 Current and Projected Water Quality 123 4/D1
III ENVIRONMENTAL IMPACTS
III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129 4/E1
III.1.1 Construction Impacts 129 4/E1
Physical Environment 129 4/E1
— Topography 129 4/E1
— Air Quality 130 4/E3
— Water Quality 131 4/E5
— Sediment Quality 132 4/E7
— Noise 132 4/E7
Biological Environment 133 4/E9
— Segment I — San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134 4/E11
— Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant 136 4/F1
— Segment III — Palo Alto Treatment Plant to Discharge Point 138 4/F5
Social, Economic, and Cultural Environment 140 4/F9
— Recreational Uses of the Area 140 4/F9

— Archaeological, Paleontological, and Historical Resources 141 4/F11
— Visual and Aesthetic Setting 141 4/F11
— Economic Setting 141 4/F11
— Present Land-Use Patterns 143 4/G1
— Projected Land-Use Patterns 144 4/G3
III.1.2 Operation Impacts 144 4/G3
Physical Environment 144 4/G3
— Hydrology 144 4/G3
— Water Quality 144 4/G3
— Sediment Quality 148 4/G11
— Noise 150 5/A13
Biological Environment 152 5/B3
Social, Economic, and Cultural Environment 154 5/B7
— Recreational Uses of the Area 154 5/B7
— Visual and Aesthetic Setting 155 5/B9
— Present and Future Land-Use 155 5/B9
— Energy Consumption 155 5/B9
III.1.3 Economic Impact of the Basin Plan Alternative 155 5/B9
Introduction 155 5/B9
Study Assumptions and Methodology 155 5/B9
— Capital Costs 156 5/B11
— Operation and Maintenance Costs 158 5/C1
Computation of Allocation Factors 158 5/C1
User Charges to Discharger Groups 159 5/C3
— Residential Dischargers 159 5/C3
— Commercial Dischargers 159 5/C3
— Industrial Dischargers 159 5/C3
— Direct Impact on Industrial Dischargers 162 5/C9
Analysis of the Canned Fruit and Vegetable Industry 163 5/C11
— Industry Characteristics 163 5/C11
— Methodology 164 5/C13
— Conclusions of Analysis 165 5/D1
Conclusions 165 5/D1
III.1.4 Accident or Natural Catastrophe 166 5/D3
Flooding 166 5/D3
Earthquake 166 5/D3
Plant Upset 166 5/D3
Pumping Station Malfunction 166 5/D3
III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168 5/D7
III.2.1 Adverse Construction Effects 168 5/D7
Physical Environment 168 5/D7
Biological Environment 168 5/D7
Social, Economic, and Cultural Environment 168 5/D7
III.2.2 Adverse Operational Effects 169 5/D9
Physical Environment 169 5/D9
Biological Environment 169 5/D9
Social, Economic, and Cultural Environment 169 5/D9
III.3 MITIGATION MEASURES 170 5/D11
III.3.1 Mitigation of Construction Impacts 170 5/D11
Proposed Measures 170 5/D11
Potential Measures 172 5/E2
III.3.2 Mitigation of Operation Impacts 173 5/E3
Proposed Measures 173 5/E3
Potential Measures 173 5/E3
III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174 5/E5
III.4.1 Short-Term Uses of Man's Environment 174 5/E5
III.4.2 Maintenance and Enhancement of Long-Term Productivity 174 5/E5
III.4.3 Need for the Project 175 5/E7
III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176 5/E9
III.5.1 Permanent Changes in Land Features and Land Use 177 5/E11
III.5.2 Biological Systems 177 5/E11
III.5.3 Assimilative Capacity of the Bay 177 5/E11
III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177 5/E11
III.6 GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178 5/E13

IV ALTERNATIVES TO THE BASIN PLAN

IV.1 INTRODUCTION 181 5/F7
IV.2 ALTERNATIVES 182 5/F9

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183 5/F11
Participation by Other Entities 184 5/F13
Alternative Alignments 184 5/F13
Result of Screening 185 5/G1
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188 5/G7
Result of Screening 190 5/G11
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190 5/G11
Result of Screening 191 5/G13
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193 6/B1
Result of Screening 195 6/B5
IV.2.5 Alternative 5 — Reclamation and Reuse 195 6/B5
Reclamation in Santa Clara County 197 6/B9
Smaller Reuse Markets in the Service Area 199 6/B13
Markets Outside the Service Area 201 6/C3
Result of Screening 202 6/C5
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202 6/C5
Result of Screening 203 6/C7
IV.2.7 Alternative 7 - Discharge to the Ocean 203 6/C7
Result of Screening 204 6/C9
IV.2.8 Alternative 8 — Land Disposal 204 6/C9
Result of Screening 205 6/C11
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206 6/C13
Result of Screening 206 6/C13

V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION

V.1 INTRODUCTION 207 6/D3
V.2 STUDY AREA 209 6/D7
V.2.1 Location of Study Area 210 6/D9
V.2.2 Water Demand and Supply 210 6/D9
V.2.3 Quality of Groundwater Supplies 213 6/E1
V.2.4 Quality of Soils 213 6/E1
V.2.5 Agricultural Land Use 215 6/E5
V.3 CONCEPTUAL DESIGN 217 6/E9
V.3.1 Potential Markets 218 6/E11
V.3.2 Reclaimed Water Quality 219 6/E13
Source Control 221 6/F3
Level of Reclaimed Water Treatment 222 6/F5
V.3.3 Treatment Conceptual Designs 224 6/F9
Reclaimed Water Flow Diversion 226 6/F13
Coagulation and Sedimentation with Alkalinity Control 226 6/F13
Alkalinity Control 230 6/G7
Partial Desalination Treatment 232 6/G11
V.3.4 Conveyance and Distribution Conceptual Designs 233 6/G13
Pumping 234 7/A13
Conveyance Pipeline 235 7/B1
Santa Clara Valley Distribution System 235 7/B3
Bolsa Distribution System 236 7/B3
User Connections 236 7/B3
V.3.5 Cost Estimates 242 7/C1
Basis of Estimate 242 7/C1
Engineering Construction Management Contingency 244 7/C5
Escalation 244 7/C5
Schedule 244 7/C5
Operation and Maintenance 244 7/C5
Major Exclusions 244 7/C5
Assumptions 244 7/C5
V.3.6 Blending Alternatives 244 7/C5
Blended Water Quality 245 7/C7
Blended Water Markets 245 7/C7
Blended Water Distribution 246 7/C9
Blending System Alternatives 247 7/C11
V.3.7 Alternating Supply Alternatives 247 7/C11
V.3.8 Summary 248 7/C13
V.4 AGRICULTURAL IMPACTS 249 7/D1
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250 7/D3
Salinity Effects 251 7/D5
Effects of High Sodium Concentrations 253 7/D9

Specific Ion Toxicity 255 7/D13
Summary of Effects on Agriculture of Cases A and B 255 7/D13
V.4.2 Impact of Cases C, D, B_1, B_2, and B_3 in the Santa Clara County Portion of the Study Area 256 7/E1
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257 7/E3
V.5 ECONOMIC IMPACT ANALYSIS 259 7/E7
V.5.1 Conceptual Level Costs 259 7/E7
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260 7/E9
V.5.3 Economic Impact on Agriculture 260 7/E9
V.6 OTHER IMPACTS 263 7/F1
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264 7/F3
V.6.2 Long-Term Buildup of Salts in Soil 265 7/F5
V.6.3 Public Health Concerns 265 7/F5
V.6.4 Effects on Land Use and Water Use 266 7/F7
V.6.5 Energy Consumption 266 7/F7
V.6.6 Other Effects 267 7/F9
VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE
VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270 7/G3
VI.1.1 Disposal of Bittern 271 7/G5
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272 7/G7
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273 7/G9
VI.1.4 Other Disposal Alternatives 276 8/A13
Continued Storage 276 8/A13
On-Land Dilution 276 8/A13
VI.2 PRESENT ENVIRONMENT 277 8/B1
VI.2.1 Physical Environment 277 8/B1
Topography 277 8/B1
Soils 278 8/B3
Sediments 278 8/B3
Hydrology 278 8/B3
Water Quality 278 8/B3
— Temperature and Salinity 278 8/B3
— Chemical Characteristics 280 8/B7
VI.2.2 Biological Environment 280 8/B7
Open Water and Tidal Mud Flats 280 8/B7
Salt Marsh 280 8/B7
Salt Ponds 280 8/B7
Dikes and Levees 282 8/B11
Streams and Sloughs 282 8/B11
Species of Special Concern 283 8/B13
VI.2.3 Social and Cultural Environment 283 8/B13
Recreational Uses of the Area 283 8/B13
Archaeological, Paleontological, Historical, and Cultural Resources 284 8/C1
Visual and Aesthetic Setting 284 8/C1
Existing and Proposed Land Use 284 8/C1
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285 8/C3
VI.3.1 Discharging to Basin Plan Alternative 285 8/C3
Construction Impacts — Physical Environment 285 8/C3
— Topography 285 8/C3
— Air Quality 285 8/C3
— Water Quality 286 8/C5
— Sediment Quality 286 8/C5
— Noise 286 8/C5
Construction Impacts — Biological Environment 286 8/C5
— Salt Pond Dikes 286 8/C5
— Open Water 286 8/C5
Construction Impacts — Social, Economic, and Cultural Environment 287 8/C7
— Recreational Uses of the Area 287 8/C7
— Archaeological, Paleontological, and Historical Resources 287 8/C7
— Economic Setting 287 8/C7
— Present and Projected Land-Use Patterns 287 8/C7
Operational Impacts — Physical Environment 287 8/C7
— Water Quality 287 8/C7
— Sediment Quality 290 8/C13
— Noise 290 8/C13
Operational Impacts — Biological Environment 291 8/D1

Operational Impacts — Social, Economic, and Cultural Environment 292 8/D3
— Economic Setting 292 8/D3
VI.3.2 Discharging Through Separate Diffusers 292 8/D3
Construction Impacts — Physical Environment 292 8/D3
— Topography 292 8/D3
— Air Quality 292 8/D3
— Water Quality 292 8/D3
— Sediment Quality 292 8/D3
— Noise 292 8/D3
Construction Impacts — Biological Environment 293 8/D5
— Salt Pond Dikes 293 8/D5
— Open Water 293 8/D5
Construction Impacts — Social, Economic, and Cultural Environment 293 8/D5
— Recreational Uses of the Area 293 8/D5
— Visual and Aesthetic Setting 293 8/D5
— Economic Setting 293 8/D5
— Present and Projected Land-Use Pattern 294 8/D7
Operational Impacts — Physical Environment 294 8/D7
— Water Quality 294 8/D7
— Sediment Quality 295 8/D9
— Noise 295 8/D9
Operational Impacts - Biological Environment 296 8/D11
Operational Impacts — Social, Economic, and Cultural Environment 297 8/D13
— Economic Setting 297 8/D13
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298 8/E1
VI.4.1 Unavoidable Adverse Environmental Impacts 298 8/E1
VI.4.2 Mitigation Measures 298 8/E1
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299 8/E3
Short-Term Uses of Man's Environment 299 8/E3
Maintenance or Enhancement of Long-Term Productivity 299 8/E3
Need for the Project 299 8/E3
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302 8/E9
Permanent Changes in Land Features and Land Use 302 8/E9
Biological Systems 302 8/E9
Assimilative Capacity of the Bay 302 8/E9
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302 8/E9
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302 8/E9

VII SOURCES OF INFORMATION

VII.1 REFERENCES 305 8/F1
VII.1.1 Literature Cited in Text 305 8/F1
VII.1.2 Literature Cited in Figures 312 8/G1
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313 8/G3
VII.3 CONTACTS 316 8/G9
VII.4 DISTRIBUTION LIST 335 9/D3
VII.4.1 Federal Agencies 335 9/D3
VII.4.2 Libraries 338 9/D9
VII.4.3 Individuals and Private Groups 339 9/D11
VII.4.4 State Agencies 347 9/E13
VII.4.5 Regional Agencies and Local Government 348 9/F1
VII.4.6 Legislators 352 9/F9
VII.4.7 News Media 353 9/F11

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

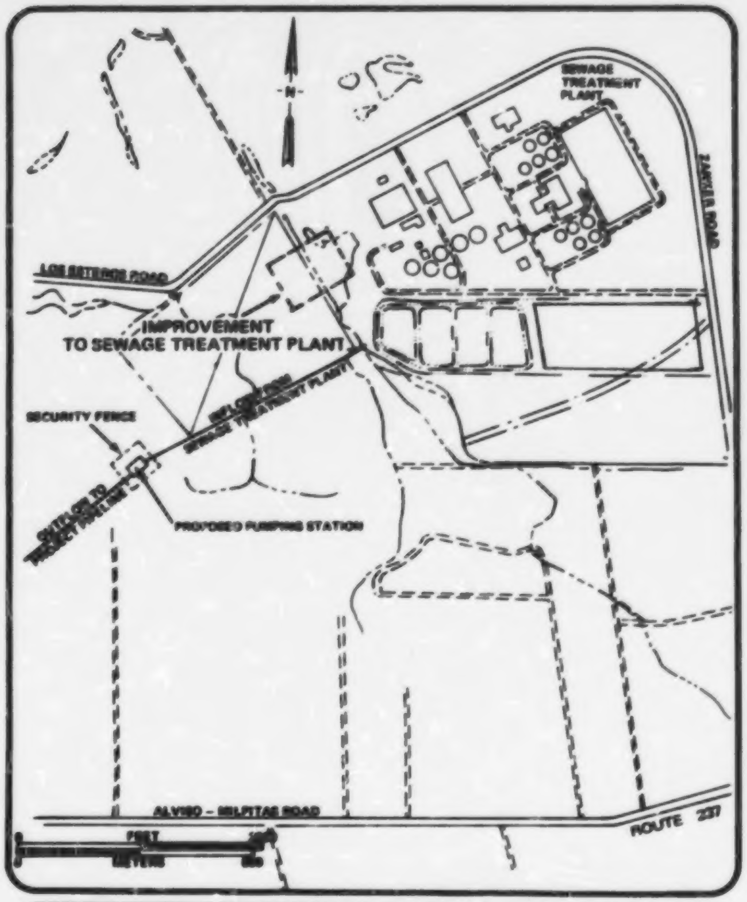

-N-
SEWAGE TREATMENT PLANT
ZANKER ROAD
LOS ESTEROS ROAD
IMPROVEMENT TO SEWAGE TREATMENT PLANT
INFLOW FROM SEWAGE TREATMENT PLANT
SECURITY FENCE
OUTFLOW TO PROJECT PIPELINE
PROPOSED PUMPING STATION
ALVISO – MILPITAS ROAD
ROUTE 237
0
FEET
1000
0
METERS
300

Figure I-8

CONCEPTUAL PUMPING STATION LAYOUT
SAN JOSE/SANTA CLARA

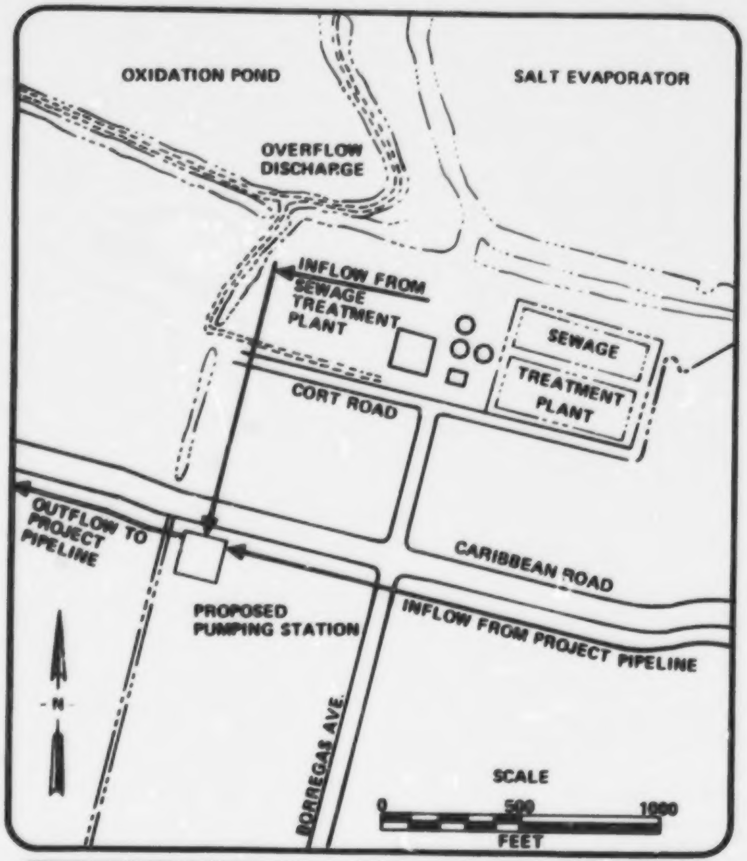

OXIDATION POND
SALT EVAPORATOR
OVERFLOW DISCHARGE
INFLOW FROM SEWAGE TREATMENT PLANT
SEWAGE TREATMENT PLANT
CORT ROAD
OUTFLOW TO PROJECT PIPELINE
CARIBBEAN ROAD
PROPOSED PUMPING STATION
INFLOW FROM PROJECT PIPELINE
-N-
BORREGAS AVE.
SCALE
0
500
1000
FEET

Figure I-9

CONCEPTUAL PUMPING STATION LAYOUT, SUNNYVALE of the pumping station would be similar to those of the San Jose/Santa Clara station. Sump capacity would be less, while pump size and the number of pumps would be greater than the San Jose/Santa Clara station, as shown in Table I-5. Due to its location next to a future industrial park expansion, the Sunnyvale pumping station would be designed so that the structure and grounds would be compatible with the surroundings. Exterior treatment would be subject to the approval of the Moffet Industrial Park.

Table I-5

SUNNYVALE PUMPING STATION
CHARACTERISTICS(1)

Specification	Season	
	Dry	Wet
Pump capacity (gpm)	44,000	47,000
Horsepower	575	1,700
No. of units		
Service	3	5
Standby	1	0
Approximate sump capacity (gal)(2)	630,000	630,000

Notes: (1) Based on the "relift system"
(2) Based on 15-minute pumping volume of one large pump

Pipeline Segment — Sunnyvale to Palo Alto

A 96-inch diameter pipeline would connect the Sunnyvale and Palo Alto treatment plants.

The route of the pipeline from Sunnyvale to the Palo Alto treatment plant (Figure I-7) would be on the south side of Caribbean Road, where the pipeline would turn west toward Mathilda Avenue. After crossing Mathilda Avenue, the pipeline would proceed adjacent to and inland from the dike along the north end of the Lockheed property and Moffett Field golf course, the Moffett Field runways, the NASA-Ames Research Center, and the proposed Mountain View Shoreline Park. The pipeline then would cross the flood channel south of Charleston Slough along Terminal Boulevard, avoiding Charleston Slough. In the Palo Alto flood control basin, the pipeline would parallel an existing 72-inch force main from the abandoned Mountain View treatment plant and would skirt the proposed Palo Alto park, avoiding existing sanitary landfill areas.

Palo Alto Pumping Station

The tentative location for the Palo Alto pumping station is shown in Figure I-10. The design, control systems, power supply, and emergency bypass (to the Palo Alto discharge channel) of the pumping station would be similar to the other stations. As shown in Table I-6, sump capacity would be the same as that of the Sunnyvale station, but the size and number of pumps would be greater than those of the other two stations. The pumping station would be an outdoor unit with appropriate landscaping and screening.

Pipeline Segment — Palo Alto to Discharge Point

In this last segment, the pipeline system would be 102 inches in diameter. The pipeline would leave the Palo Alto pumping station (Figure I-7), pass through the Palo Alto Airport tiedown area, cross the levee near the present discharge point, and follow the outfall channel to Mayfield Slough channel. At the navigation channel in South San Francisco Bay, the line would turn northwest to the disposal area north of Dumbarton Bridge. Offshore, the pipeline would be buried with a minimum cover of four to five feet.

Diffuser

The diffuser, would be designed to provide a steady state volume dilution of 16:1 for a conservation (nondegradable) substance, would be located in the navigation channel about one mile north of the Dumbarton

Bridge. It would be centered and anchored in the channel, on support pilings, if necessary, and oriented perpendicular to the main pipeline system. The diffuser would be a multiple port system. It is currently envisioned as having 9-inch diameter ports placed at 15-foot centers. The diffuser would consist of 450 feet of 6-foot diameter pipe and 256 feet of 4-foot diameter pipe.

Table I-6

PALO ALTO PUMPING STATION CHARACTERISTICS(1)

Specification	Season	
	Dry	Wet
Pump capacity (gpm)	45,000	42,000
Horsepower	725	2,000
No. of units		
Service	4	7
Standby	1	0
Approximate sump capacity (gal)(2)	630,000	630,000

Notes: (1) Based on the "relift system"
(2) Based on 15-minute pumping volume of one large pump

I.2.3 CONSTRUCTION OF THE BASIN PLAN ALTERNATIVE

Construction procedures for the pipeline would differ, depending on the terrain, e.g., construction on land in contrast to water. In general, construction would be planned to occur only during the months when the ground is dry and local streams are at annual low-flow. Figure I-11 presents a tenative construction schedule for the various phases of the project. The construction schedule would be sufficiently flexible to avoid affecting wildlife species, especially the nesting periods of the California Clapper Rail.

Construction Procedures on Land

To complete the project on schedule, it would be necessary for four or more pipeline construction teams, called "spreads," to work simultaneously at several points along the proposed route. Each spread would have the equipment necessary to:

- Prepare the construction easement for the passage of other equipment
- Haul and lay out the lengths of pipe
- Dig the trench
- Lower the pipe into the trench
- Backfill
- Clean up and restore or stabilize the surfaces and slopes within the construction easement

Typically, the construction easement would be 150 feet wide, and the trench deep enough to allow four feet of cover over the pipeline (Figure I-10). Top soil would be separated and stockpiled for use in restoration of the right-of-way after construction is completed. Subsoil (spoils) would be used as backfill in the trench; excess spoils would be disposed of in an approved landfill in the Baylands region. It is possible that excess spoil, if of suitable quality, and if available at a suitable time, could be used as fill for the Mountain View Regional Shoreline Park.

Construction equipment and materials would typically be deployed and stored on the perimeter of the construction easement. In restricted areas where the width of the working strip must be narrowed, separate temporary storage and staging areas would be developed as near to the site as practical to store pipe, materials, trucks, sideboom tractors, trenching, and welding equipment, and to provide additional construction room. These areas would be approximately 150 feet by 250 feet and would normally be in vacant lots or fields. Some areas might require minor grading, but none should require major surface alterations. During cleanup operations, all temporary storage and work areas would be returned to their original condition.

The specific amount, size, and kind of construction equipment used in a spread would be determined by a number of factors. Preparation of the trench would require ditching machinery, draglines, or clamshell dredges, depending on soil conditions. Sideboom tractors would be used for the positioning of pipe, for lifting and maneuvering the pipe, and for placing the pipe in the trench. Special tractor equipment, such as angle-dozers, would be used to cover the pipe and restore normal surface contours.

Transport trucks and construction traffic would be confined to roads and to the pipeline right-of-way. Access roads would be required to transport pipe, materials, and equipment to the various sections of the right-of-way. Some existing roads and temporary construction roadways might require minor improvements and grading; however, no major modification of access roads is anticipated. Most access would be through open (nonresidential) or industrial areas. In residential areas, routes with acceptable surfaces carrying the least amount of traffic would be used. The temporary construction roadway terrain would be returned to its original condition.

The width of the construction easement would be narrowed where space is limited or where adjacent to environmentally sensitive areas, and construction activities would be modified where normal techniques would be incompatible with existing local land uses.

Construction Procedures in Water

All construction operations in mud flats outside the South Bay levee system and in deeper water would be performed with the aid of barges and dredges.

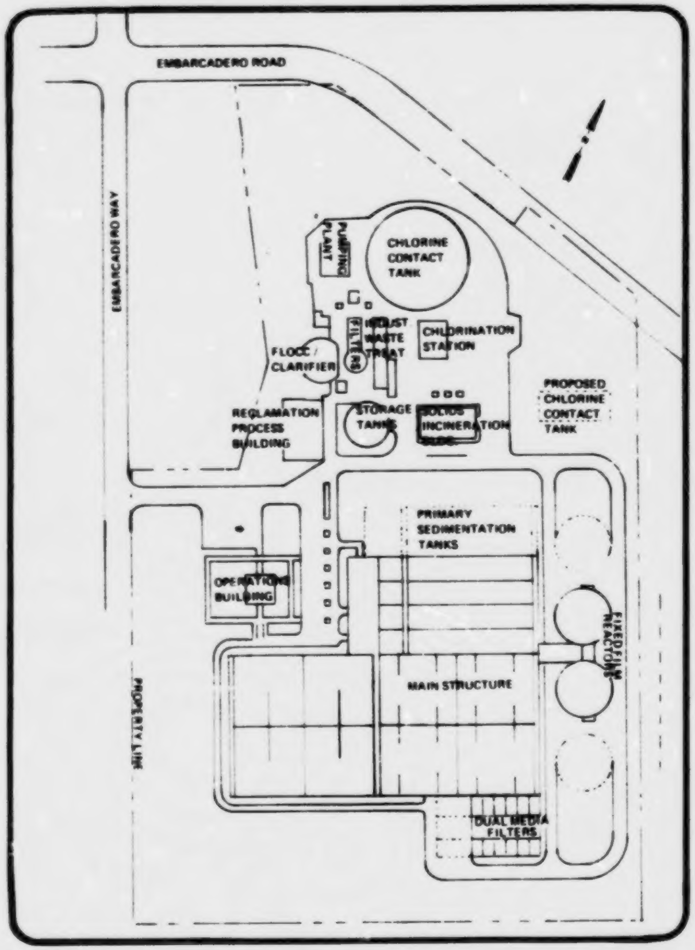

EMBARCADERO ROAD
EMBARCADERO WAY
PUMPING PLANT
CHLORINE CONTACT TANK
FILTERS
INDUST WASTE TREAT
CHLORINATION STATION
FLOCC / CLARIFIER
RECLAMATION PROCESS BUILDING
STORAGE TANKS
SOLIDS INCINERATION BLDG
PROPOSED CHLORINE CONTACT TANK
PRIMARY SEDIMENTATION TANKS
OPERATIONS BUILDING
FIXED FILM REACTORS
MAIN STRUCTURE
DUAL MEDIA FILTERS
PROPERTY LINE

Figure I-10
CONCEPTUAL PUMPING STATION LAYOUT, PALO ALTO

Dredging would result in the removal of approximately 700,000 cubic yards of dredged spoils that would be disposed of off Alcatraz Island (a spoils disposal area approved by the Regional Water Quality Control Board, the Environmental Protection Agency, and the U.S. Army Corps of Engineers). Clean backfill obtained from Bay Area sources would be placed in the trench after the assembled pipeline is in place.

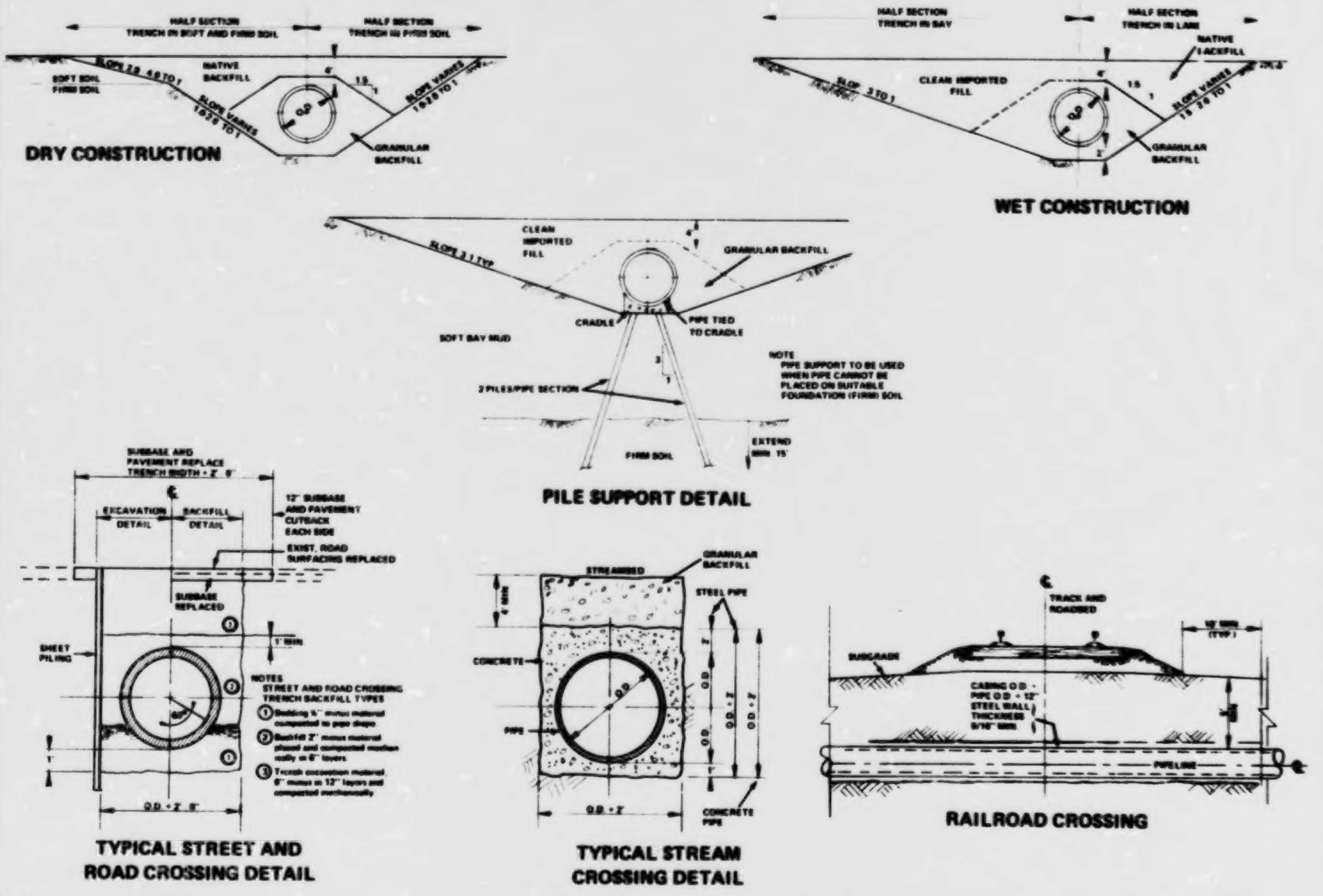

HALF SECTION TRENCH IN SOFT AND FIRM SOIL
HALF SECTION TRENCH IN FIRM SOIL
SOFT SOIL
FIRM SOIL
SLOPE 2.0 4.0 TO 1
NATIVE BACKFILL
SLOPE VARIES 1.0 2.0 TO 1
6'
1.5 1
O.D.
GRANULAR BACKFILL
DRY CONSTRUCTION
HALF SECTION TRENCH IN BAY
HALF SECTION TRENCH IN LAND
NATIVE BACKFILL
SLOPE 2 TO 1
CLEAN IMPORTED FILL
SLOPE VARIES 1.5 2.0 TO 1
2'
GRANULAR BACKFILL
WET CONSTRUCTION
CLEAN IMPORTED FILL
SLOPE 2:1 TYP
GRANULAR BACKFILL
CRADLE
PIPE TIED TO CRADLE
SOFT BAY MUD
3
1
2 PILES/PIPE SECTION
NOTE
PIPE SUPPORT TO BE USED WHEN PIPE CANNOT BE PLACED ON SUITABLE FOUNDATION (FIRM) SOIL
FIRM SOIL
EXTEND MIN 15'
PILE SUPPORT DETAIL
SUBBASE AND PAVEMENT REPLACE TRENCH WIDTH + 2' 0"
℄
EXCAVATION DETAIL
BACKFILL DETAIL
12" SUBBASE AND PAVEMENT CUTBACK EACH SIDE
EXIST. ROAD SURFACING REPLACED
SUBBASE REPLACED
SHEET PILING
1' MIN
1'
NOTES
STREET AND ROAD CROSSING TRENCH BACKFILL TYPES
① Bedding ¾" minus material compacted to pipe shape
② Backfill 2" minus material placed and compacted mechanically in 6" layers
③ Trench excavation material, 6" minus in 12" layers and compacted mechanically
O.D. + 2' 0"
TYPICAL STREET AND ROAD CROSSING DETAIL
STREAMBED
GRANULAR BACKFILL
STEEL PIPE
4' MIN
CONCRETE
PIPE
O.D.
O.D. + 2'
CONCRETE PIPE
TYPICAL STREAM CROSSING DETAIL
℄
TRACK AND ROADBED
SUBGRADE
12' MIN (TYP)
CASING O.D. = PIPE O.D. + 12" STEEL WALL THICKNESS 9/16" MIN
PIPELINE
RAILROAD CROSSING

Figure I-11
TYPICAL CONSTRUCTION DETAILS

I.2.4 OPERATION OF THE BASIN PLAN ALTERNATIVE

As discussed in Section 1.1, the purpose of the Basin Plan project is to collect the treated effluent from the water pollution control plants at San Jose/Santa Clara, Sunnyvale, and Palo Alto and convey this effluent to a disposal area located north of Dumbarton Bridge.

All San Jose/Santa Clara effluent flows would be conveyed to a sump at Sunnyvale to which Synnyvale flows would be added. All flows would then be pumped to a sump at Palo Alto. The Palo Alto flows would be collected, and the total volume pumped to the disposal area. This procedure, the "relift" system, results in simpler hydraulic operations, lower pipeline pressures, and more uniform pumping equipment than in a continuous system.

In a continuous system, each discharger would tap into the conveyance line. Pressures in the connecting lines would have to be maintained to match the pressure in the conveyance; any relative drop in connector line pressures would result in flows from the conveyance to the plant. For this reason, a continuous system requires different equipment design for each discharger, including valving, junction boxes, and pumps of varying horsepower.

In 1995, annual energy requirements are estimated to be approximately 14.21 x 10^6 kilowatt-hours for peak flows. Current (1978) flows would require about 4.73 x 10^6 kilowatt-hours. Average annual energy consumption for 1980 (estimated first year of operation) would be 7.88 million kilowatt-hours per year, with a cost of approximately $212,000 at current prices.

Upon commencement of operation of the Basin Plan Alternative, present modes of effluent discharge to Artesian Slough for San Jose/Santa Clara, to Guadalupe Slough for Sunnyvale, and to the discharge canal and offshore disposal site for Palo Alto would be terminated.

Construction activities in areas that require modified techniques include:

- Placing of support pilings in areas of thick (20 feet or more), soft Bay Mud
- Special precautions at dikes to prevent breaching
- Construction of access channels for barge equipment in shallow mud flat and tidal areas

1.3

APPROVALS REQUIRED

The known agency approvals and permits required to implement the recommended project are listed in Table 1-7.

Table 1-7

LISTING OF POTENTIAL AGENCY AND PERMIT REQUIREMENTS

Agency and/or Authority	Permit or Approval Required
1. Environmental Protection Agency	Certification of EIS; granting of funds; dredge spoils disposal
2. State of California Water Resources Control Board	Certification of EIR; granting of funds
3. U.S. Army Corps of Engineers	Permit for work in navigable waters and dredge spoil disposal
4. U.S. Coast Guard	Permit for work in navigable waters
5. State of California Lands Commission	Permit for work strips through state-owned lands (tidal and submerged)
6. State of California Department of Fish and Game	Statement or agreement regarding streambed alteration notification
7. San Francisco Bay Conservation and Development Commission (BCDC)	Permit for work in Bay and lands under BCDC jurisdiction

8. California Regional Water Quality Control Board - San Francisco Bay Region	Water quality certification
9. Santa Clara Flood Control District	Easement through fee lands
10. Santa Clara County	Building permits
11. San Mateo County	Building permits
12. City of San Jose	Use permit
13. City of Santa Clara	Use permit
14. City of Sunnyvale	Use permit
15. U.S. Government — U.S. Naval Air Station Moffett Field	Use permit
16. U.S. Government — NASA Ames Research Center	Use permit
17. City of Mountain View	Use permit
18. City of Palo Alto	Use permit
19. City of Menlo Park	Use permit
20. Southern Pacific Transportation Company	Permission for straight crossing of easements
21. Hetch Hetchy Water and Power Department (S.F. Water Dept.)	Permission for straight crossing of easements
22. Pacific Gas and Electric Company	Easement of longitudinal encroachment; permission for straight (perpendicular) crossing of eastments

Section II

ENVIRONMENTAL DESCRIPTION

II.1

(ENVIRONMENTAL SETTING
PRESENT ENVIRONMENT
WITHOUT A PROJECT)

II.1.1 PHYSICAL ENVIRONMENT

The existing physical environmental setting is described in this section. Regional characteristics are described for most parameters, although emphasis is placed on the Basin Plan Alternative corridor. Where additional information is desired, the references cited in each section should be consulted. The State Water Resources Control Board *Tentative Water Quality Control Plan* (1974) also has additional information on most topics.

Topography

The San Francisco Bay Area lies in the central coastal section of the Coast Range Province, which consists of mountain ranges and valleys trending north by northwest. This province is bounded on the west by the Pacific Ocean and on the east by the Central Valley. The depression containing South San Francisco Bay is a structural trough bounded by the low hills of the San Francisco Peninsula to the west and a low plain sloping gently to the base of the Berkeley Hills to the east. The southern end of the Bay forms the northern boundary of the Santa Clara Valley, an alluvial lowland extending to the southwest within the large structural trough (Figure II-1).

The Bay waters neighboring the Basin Plan Alternative alignment are generally shallow; water depths average less than 10 feet in the project area. The low-lying Baylands (that area from the Bay shoreline up to the 10-foot contour above mean sea level of Santa Clara and San Mateo Counties) are comprised of salt evaporation ponds, sloughs, marshes, and tidal mud flats. Dry areas are used for agriculture, light industry, commerce, and landfill. The land surface along the Basin Plan Alternative route is nearly level; surface elevations are approximately zero to five feet above mean sea level, although some areas are slightly below sea level. The land traversed by the Basin Plan Alternative alignment is protected from flooding at high tide by an extensive system of dikes and levees (Santa Clara Valley Water District, 1974). In the event of dike failure, flooding can and does occur, such as the flood that inundated

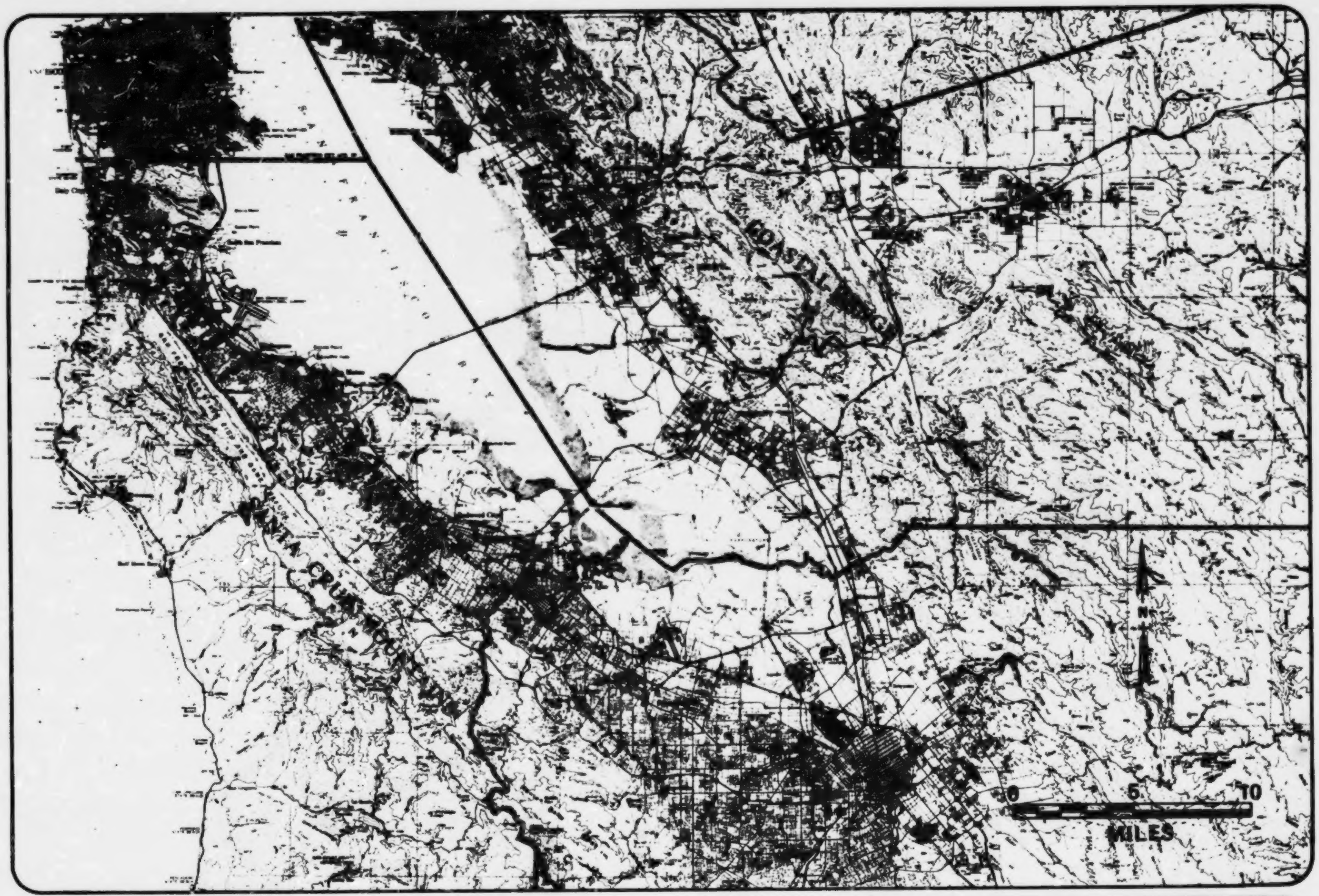

COASTAL
SANTA CRUZ
N
0
5
10
MILES

Figure II-1
TOPOGRAPHY

Alviso in 1963. Figure II-2 illustrates the general area along the terrestrial portion of the Basin Plan Alternative alignment potentially subject to saltwater flooding. Additionally, much of the lowland is subject to fresh water flooding from streams and sloughs swollen by seasonal storms when their outflows into the Bay are hindered by high tides and wind-driven waves (Santa Clara Valley Water District, 1974).

Geology and Seismology

The Franciscan formation, an assemblage of sedimentary, volcanic, and metamorphic rocks 70 to 180 million years old (Jurassic to Cretaceous), is the basement unit in the Bay Area. Unconsolidated alluvial deposits, composed of varying amounts of clay, peat, and gravel, overlie the basement rock. The structural trough containing South San Francisco Bay was formed during the Pliocene and early Pleistocene by warping and faulting. During the Pleistocene, a great thickness of sediments accumulated in the trough. These deposits are the surface feature of much of the Santa Clara Valley and in places have been deformed by crustal compression. Beneath the San Francisco Bay and in areas surrounding the South Bay, the Pleistocene deposits have been covered by recent sediments (Bay Mud) up to 140 feet thick. This layer of Bay Mud forms the surface statum along the Basin Plan Alternative alignment, as shown in Figure II-3 (Schlocker, 1971).

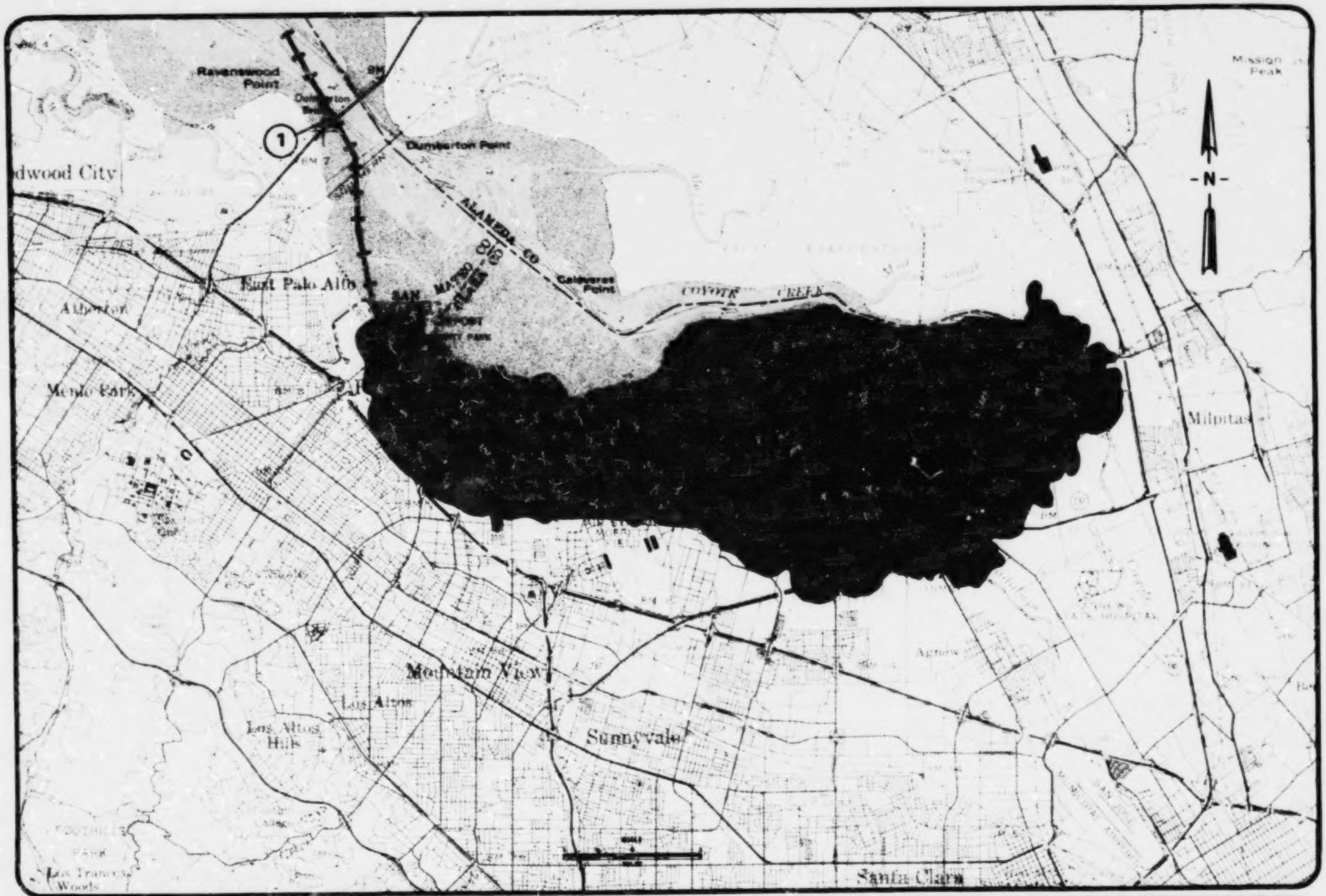
The Bay Area is a region of major tectonic and seismic activity. Earthquakes occur frequently in the area, although most of them are small enough to be detectable only with seismographs. Rarely are they large enough to cause property damage. Two or three major earthquakes, such as the one that struck the Bay Area in 1906, have been recorded in California during the last 150 years (Brown and Lee, 1971).

The major seismic structural features of the San Francisco Bay Region are the San Andreas Fault Zone to the west of the Bay and the Hayward Fault Zone to the east (Figure II-3. The San Andreas Fault is the principal fault in California and is over 650 miles in length. It passes about eight miles southwest of the proposed pipeline route. The fault is seismically active and has been the source of a number of severe earthquakes in the past, including the 1906 earthquake. The Hayward Fault Zone is located east of the Bay along the western base of the Berkeley Hills. This zone is also seismically active and has shown measurable right-lateral movements along the fault trace in recent years.

Another physical phenomenon common to this area — in this case man-induced — is ground surface subsidence, characterized by a reduction in the ground surface elevation over large areas. Subsidence of up to 13 feet has occurred in parts of the Santa Clara Valley. This is due to excessive withdrawal of groundwater from deep aquifers and the associated reduction in piezometric pressures, resulting in consolidation of the clay layers overlying these aquifiers as the groundwater level was lowered (Poland, 1972). This generally does not present a hazard to structures contemplated in the Basin Plan Alternative. However, much of the study area – all of the salt ponds and a fringe of dry land including part of the community of Alviso – has subsided below sea level and is susceptible to saltwater flooding in the event of failure of existing levees. Land surface subsidence has not occurred since 1969 because an area-wide program of groundwater recharge accompanied by above-normal rainfall has raised groundwater levels above the critical pressure elevation (Santa Clara Valley Water District, 1974), but renewed groundwater exploitation in severe drought years, such as the recent 1976-1977 California drought, may result in a recurrence of this subsidence.

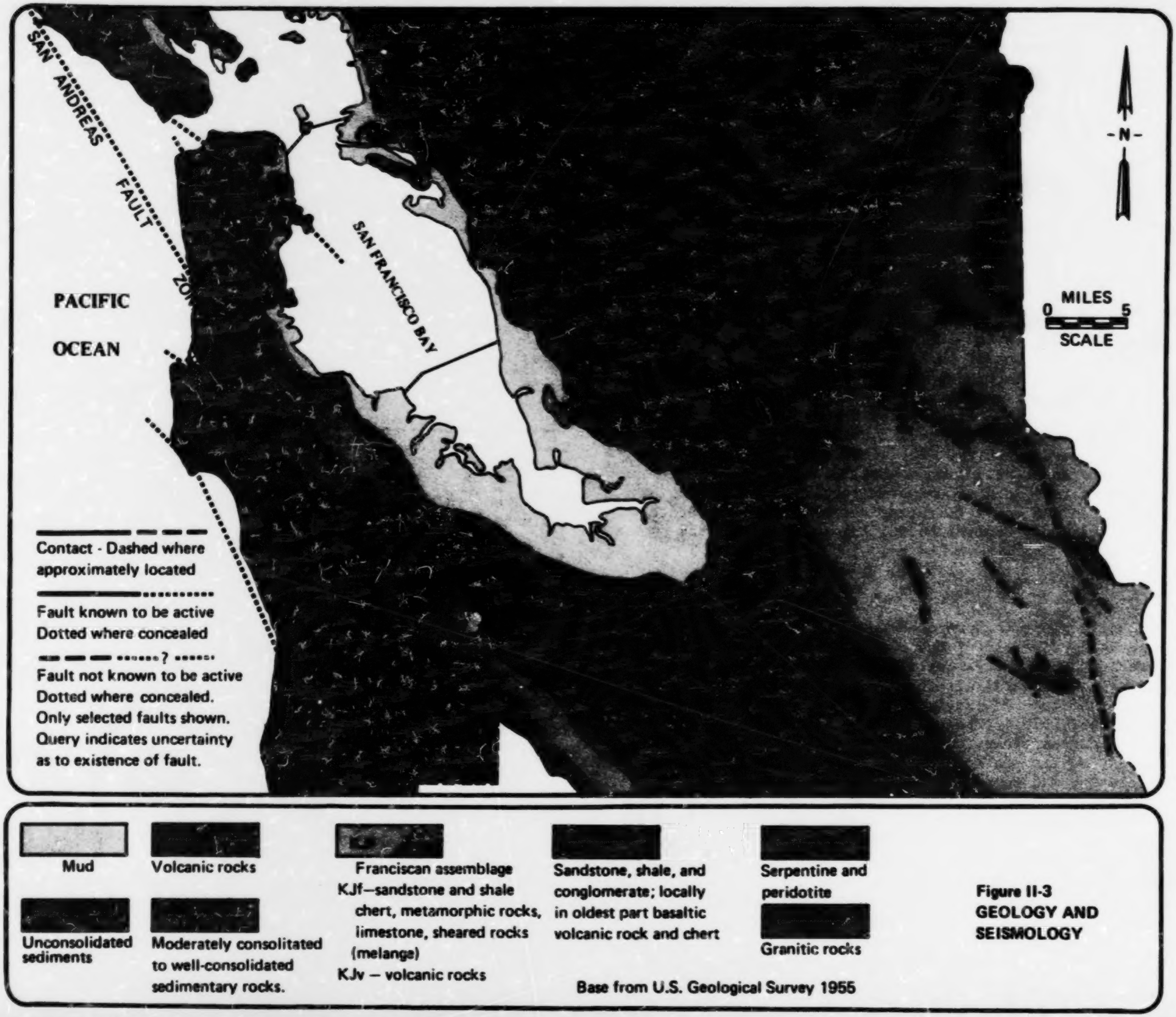
Groundwater

The study area is located within the large Santa Clara Valley Groundwater Basin, which encloses South San Francisco Bay and extends to the southern end of the Santa Clara Valley. In the vicinity of the South Bay, aquifers have formed from ancient deposits overlain by recent alluvial material. Along the valley edges, the aquifers are composed of gravelly and sandy alluvial deposits. The gravelly layers become interspersed


Ravenswood Point
Dumbarton Point
1
dwood City
ALAMEDA CO
Calaveras Point
COYOTE CREEK
East Palo Alto
Atherton
Menlo Park
Mission Peak
-N-
Milpitas
Agnew
Mountain View
Los Altos
Los Altos Hills
Sunnyvale
Santa Clara
FOOTHILLS PARK
Los Trancos Woods

① BASIN PLAN ALTERNATIVE

Figure II-2
AREA SUBJECT TO SALTWATER FLOODING


SAN ANDREAS FAULT ZONE
PACIFIC OCEAN
SAN FRANCISCO BAY
N
MILES
0
5
SCALE
Contact - Dashed where approximately located
Fault known to be active Dotted where concealed
?
Fault not known to be active Dotted where concealed. Only selected faults shown. Query indicates uncertainty as to existence of fault.
Mud
Volcanic rocks
Franciscan assemblage KJf—sandstone and shale chert, metamorphic rocks, limestone, sheared rocks (melange) KJv — volcanic rocks
Sandstone, shale, and conglomerate; locally in oldest part basaltic volcanic rock and chert
Serpentine and peridotite
Unconsolidated sediments
Moderately consolitated to well-consolidated sedimentary rocks.
Granitic rocks

Base from U.S. Geological Survey 1955

Figure II-3
GEOLOGY AND SEISMOLOGY

with fine-grained deposits near the center of the aquifers, and the coarser materials gradually thin out and become separated and confined by thick clay layers as the aquifers approach the Bay. Throughout the basin, primary and secondary aquifers range from 50 to 4,000 feet in depth (State Water Resources Control Board, 1974).

Except in shallow depths in some areas, groundwater is generally good to excellent quality bicarbonate water suitable for most uses (Table II-1). Along the conveyance alignment, however, excess groundwater withdrawal (which has also caused surface subsidence) has induced saline water intrusion from the South Bay into the groundwater. Wells in the Palo Alto area within a few miles of the Bay have shown accelerating deterioration; increases in chloride and dissolved solid concentrations have been noted, especially in shallow wells at depths of less than 150 feet. This saltwater intrusion has caused concern to local users and concerned agencies. Reclaimed wastewater from the Palo Alto water pollution control plant has been approved for use in a groundwater recharge plan, which would create a barrier against saline intrusion (State Water Resources Control Board, 1974; Jenks and Adamson, 1974).

Soils

The soils along the proposed conveyance alignments are comprised primarily of Bay Mud deposited within the last 10,000 years. A detailed field survey of the soils along several alternative pipeline alignments has been completed (Harlan Engineers and Applied Soil Mechanics, 1973). The Bay Mud is primarily silt- and clay-sized particles, containing, in places, several percent of fine to coarse grained sand. The thickness of the Bay Mud ranges from zero to 35 feet along the proposed alignment, although in some parts of the Bay, it is considerably deeper. The mud is generally underlain by firm to stiff clay and sand deposits. In a few areas, especially those portions of the proposed alignment farthest from the open waters of the Bay, the alluvial sand and silt lie at or near the surface. Some areas adjacent to the route are covered with shallow landfill of varying compositions.

Table II-1

GROUNDWATER QUALITY OF SANTA CLARA BASIN,
SOUTH BAY AREA
(SWRCB 1974)

Parameter	Concentration		
	High	Median	Low
Total dissolved solids (mg/l)	1,750	336	226
Chloride (mg/l)	698	25	6
Sulfate (mg/l)	162	45	8.6
Total hardness (mg/l)	778	242	96
Boron (mg/l)	2.4	0.1	0.0
Sodium (percent)	59	22	12

For structural purposes, Bay Mud is unstable. Natural drainage is poor, and permeability is low. The mud may subside, settle differentially, shear, shrink and crack when dried, and expand and become a plastic when wet. Bay Mud also has a high potential for lurching and sliding during earthquake tremors. In the event of a future large earthquake on the San Andreas or Hayward faults, the possibility exists that lateral spreading of the Baylands soils could create a potential for damage to a conveyance pipeline. Bay Mud itself has a low potential for liquefaction, although it is possible that sandy lenses in the mud below the water table could undergo liquefaction during an earthquake. It is not known with certainty whether liquefaction or any other type of movement occurred in Bay Mud during the large earthquakes of the past.

In drained and dried areas, the top few feet of mud become desiccated and stronger than the underlying layers (Schlocker, 1971). For further information on Baylands soils see State Water Resources Control Board (1974).

Sediments

The sediments beneath the waters of South San Francisco Bay are comprised of a thick layer of soft Bay Mud underlain by a layer of moderately dense to very dense sand and silt. The Bay Mud is the dominant and most important surficial sediment throughout the Bay. Although the thickness of the mud layer varies greatly, as a general rule, locations with shallower water depths have deeper mud deposits. The mud in the mud flats is normally 25 to 40 feet deep, while in the deep water channels it is sometimes less than 5 feet deep.

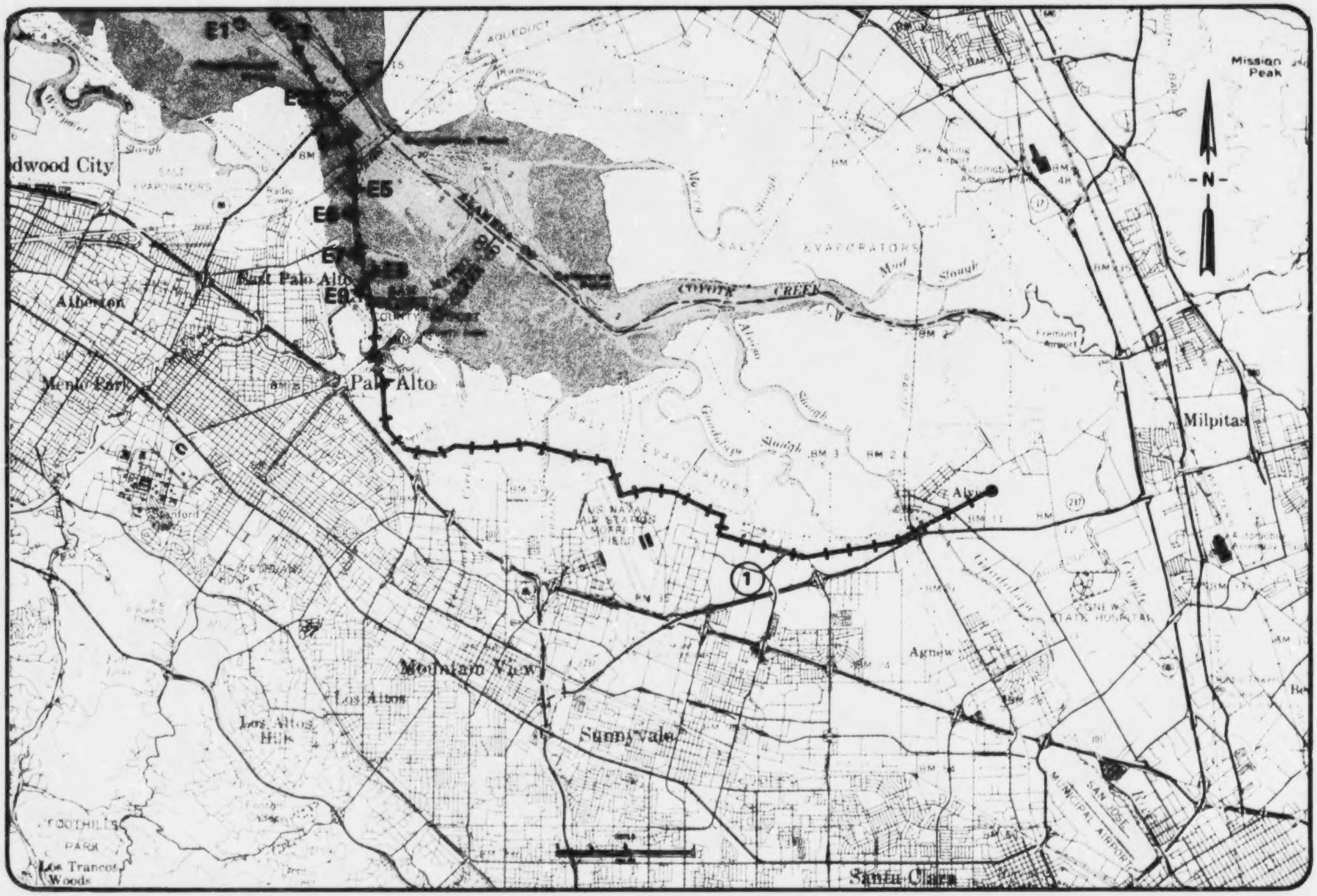
A comprehensive survey of the sediments along the Basin Plan Alternative alignment, carried out by Harlan Engineers and Applied Soil Mechanics (1973), showed that although local variations do exist, the basic characteristics of the Bay Mud deposits are uniform throughout the area. As in the terrestrial deposits outside the perimeter of the Bay, the sediment mud is composed primarily of soft clay and silt interspersed in some areas with layers of fine, unconsolidated sand. At the deep water discharge site north of the Dumbarton Bridge (see Section I.1.3), the mud layer (with a sand component) is approximately 14 feet thick. In the flats under the Dumbarton Bridge, along the Basin Plan Alternative alignment, the mud layer is 35 to 40 feet deep. Across the mud flats between the bridge and the area near San Francisquito Creek, where the Basin Plan Alternative alignment crosses to land, the thickness of the Bay Mud ranges around 25 feet. At the creek mouth, however, the mud is relatively firm and only 16 feet deep. Between the creek and the Palo Alto treatment plant, the terrestrial muds are 13 to 16 feet deep. The layers beneath the muds are firmer layers of stiff silts and clays and dense sand throughout the study area.

In 1973, shallow borings were made at seven locations in open water and analyzed for several chemical parameters. Figure A-1 in Appendix A illustrates the locations of the sediment sampling stations. Stations 3-W, 4-W, 5-W, 6-W, and 8-W are located in relatively deep water. Stations 2-W and 7-W are located in shallow mud flats. Only station 2-W is adjacent to the proposed pipeline alignment. At each station, the top layer of sediment was analyzed, as well as sediment 5 feet and 10 feet below the mud surface. Results of the analyses are presented in Appendix A.

In 1975, another sediment survey was carried out by R.C. Harlan and Associates for the South Bay Dischargers Authority. Nine sediment borings were taken along the Basin Plan Alternative alignment between the discharge point north of Dumbarton Bridge and the Bay shore near Palo Alto. Boring locations are shown in Figure II-4. Bay Mud up to 18 feet deep was found at each location. (Boring depth was limited to 18 feet.) Preliminary physical descriptions of the sediments are presented in Table II-2, and the final report is included in Appendix B.

Several of the chemical parameters are of interest because EPA regulations have been promulgated that determine when dredged material from pipeline construction can be disposed in open water. Regional EPA criteria for disposal of dredged spoil are presented in Table II-3. If the concentration of any contaminant in the spoils exceeds the level stated in the table, the spoil cannot be disposed of in open estuarine or shallow marine waters. The data collected in 1973 and 1975, with one possible exception, show that the sediment from all locations in the South Bay meet EPA criteria and may be disposed of in open water, as proposed, at the Alcatraz disposal site. The one exception is the level of cadmium (Cd) recorded in samples collected in 1973. For all samples at all depths, the 1973 Cd levels, reported as 0.0005 percent or 5.0 parts per million (ppm), appear to exceed the EPA criterion of 3.2 ppm. However, at the time the samples were collected, the lower limit of detectability of the test equipment used was 5.0 ppm. Cadmium concentrations in these 1973 samples, reported as less than or equal to 5.0 ppm, may still meet criteria; 1975 samples showing Cd levels of less than 2.0 ppm indicate that this is the case.

New criteria for dredged spoil disposal will be promulgated in the near future by the Region IX Office of the EPA and the U.S. Army Corps of Engineers, San Francisco


E1
E5
E6
E7
E8
E9
dwood City
Salt Evaporators
Alberton
East Palo Alto
Menlo Park
Palo Alto
Stanford
Salt Evaporators
Coyote Creek
Mud Slough
Guadalupe Slough
BM 3
BM 2
Alviso
US Naval Air Station Moffett Field
1
Fremont Airport
Milpitas
Mission Peak
N
Agnew
Agnews State Hospital
Mountain View
Los Altos
Los Altos Hills
Sunnyvale
Santa Clara
San Jose Municipal Airport
Foothills Park
Los Trancos Woods

SOURCE:
R. C. HARLAN & ASSOCIATES
SOUTH BAY OUTFALL
JUNE, 1975

LEGEND:
⊕ BORING LOCATION
① BASIN PLAN ALTERNATIVE

Figure II-4 SEDIMENT BORING LOCATIONS

District. Thus, before permits to construct any of the in-Bay disposal alternatives may be obtained, appropriate regulatory agencies will be contacted to determine if new criteria apply to the SBDA system and if further data acquisition will be required to comply with these criteria.

Table II-2

SOUTH BAY DISCHARGERS AUTHORITY
PROPOSED JOINT OUTFALL PIPELINE ALIGNMENT
PRELIMINARY SEDIMENT DESCRIPTION
(R.C. Harlan and Associates, 1975)

Boring Location	Sediment Depth (ft) and Description
E1	0-9 — soft grey silty clay (Bay Mud) and shells
	9-18 — grey medium sand with shells
E2	0-15 — soft grey silty clay (Bay Mud) with shells below 9 feet
	15-18 — stiff tan and grey silty clay
E3	Same as E2
E4	0-18 — soft grey silty clay (Bay Mud)
E5	0-12 — soft grey silty clay (Bay Mud)
	12-18 — loose medium to coarse grey sand and layers of soft grey silty clay (Bay Mud)
E6	0-12 — soft grey silty clay (Bay Mud)
	12-18 — loose grey medium sand and gravel
E7	0-18 — soft to stiff grey silty clay (Bay Mud)
E8	0-9 — soft grey silty clay (Bay Mud) with minor sand lenses
	9-18 — stiff to very stiff grey silty clay (Bay Mud)
E9	0-12 — soft to stiff grey silty clay (Bay Mud) and layers of peat up to 6 inches
	12-18 — stiff grey and black silty clay (Bay Mud)

Table II-3

ENVIRONMENTAL PROTECTION AGENCY, REGION IX
DREDGE SPOIL DISPOSAL CRITERIA (REVISION 2)
FOR POLLUTED SPOIL
(EPA, Region IX, 1975)

Potential Contaminant	Concentration (ppm)(1)
Mercury	1.7
Cadmium	3.2
Lead	110
Zinc	250
Oil and Grease	2,800

Note: (1) On a dry-weight basis

Meteorology

The climate of the San Francisco Bay Area is dominated by local topography, with the Pacific Ocean, San Francisco Bay, the coastal mountains, and the Berkeley Hills each playing a significant role in modifying local climatic characteristics. In general, areas close to the Bay or ocean seldom experience extremely low or high temperatures or severe storms. However, the factors of weather and topography that contribute to a very temperate climate in the Bay Area also contribute strongly to aggravating air pollution problems. The Coast Range and the Berkeley Hills surrounding San Francisco Bay form a clearly defined air basin, with penetrations inland through the Carquinez Strait, seaward through the Golden Gate, and southward through the Santa Clara Valley. The high land elevations around the Bay form an efficient barrier to the free flow of air and, particularly during the periods when an inversion is present (much of the year), contribute

---

* The San Francisco Bay Area Bay Basin consists of all of Napa, Marin, Contra Costa, San Francisco, San Mateo, Alameda, and Santa Clara Counties, and the southern part of Sonoma and the western part of Solano Counties (State Air Resources Board, 1972).

to the trapping and accumulation of pollutants in the lower layers of the atmosphere. This situation occurs with regularity and causes occasional prolonged periods of adverse air quality.

The local southern Bay Area climate is quite pleasant year-round. The annual temperature averages 59.4 degrees Fahrenheit, with a mean January daily minimum of about 40 degrees, and a mean June daily maximum near 80 degrees. Precipitation occurs primarily during the period December through March and averages nearly 13 inches per year. During the summer dry season, precipitation often does not occur for periods of a month or more. Local climatological data for the Bay Area are shown in Figures II-5 and II-6. These figures are summaries of general meteorological data for San Jose, Moffett Field, and San Francisco Airports. These data show the differences in local meteorological conditions, many of which are related to topographic influences, which, in turn, play a major role in air quality differences.

Air Quality

Achieving air quality standards in the San Francisco Bay Area is the responsibility of the Bay Area Air Pollution Control District (BAAPCD). The BAAPCD is a regional agency with jurisdiction covering all or part of the nine counties around the Bay comprising the San Francisco Bay Air Basin, as defined by the State of California.* The BAAPCD has authority over all sources of air pollution in the basin except motor vehicles, which remain the responsibility of the state. The project is located in an area that has been designated a non-attainment area for the following pollutants: oxidants, total suspended solids, and carbon monoxide. Within this area, non-attainment plans are presently being developed that will address this problem and solutions to it.

The Air Pollution Problem in the Bay Area. Air pollution results when pollutants are emitted into the ambient atmosphere at rates that produce concentrations which exceed National Air Quality Standards. The ability of the air to disperse pollutants is a function of the area meteorology and topography and varies widely over time. The combination of strong subsidence inversions common along the Pacific Coast with a basin ringed by mountains and open to the sea results in a high potential for impaired air quality in the Bay Area.

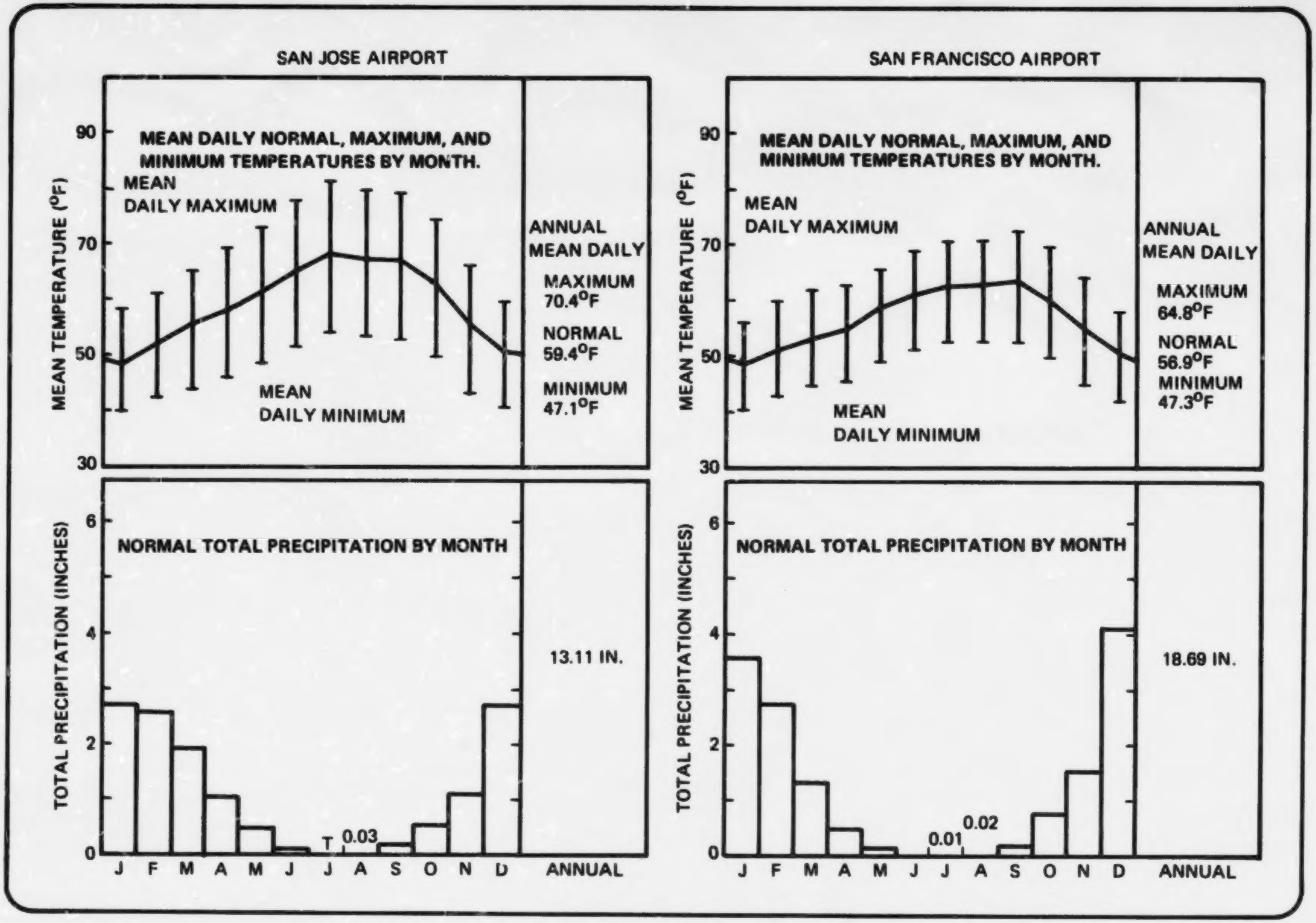
Figure II-7 (A and B) depicts in a general way the change in ventilation in the Bay Area and inversion strength or intensity on a monthly basis, with an emphasis on South Bay data. Percent sunlight is also included because sample sunlight is essential for the production of photochemical oxidant ("smog").

The ventilation index, a measure of the quantity of air available to absorb pollutants, is highest in the spring months and lowest in the summer and early fall. Inversion intensity peaks in the summer and early fall. Therefore, the air pollution potential is highest from June through October.

Since no major gaps exist to the south and east (the direction of the prevailing winds) in the mountains surrounding the Santa Clara Valley, ventilation is limited, and the air pollution potential of the southern Bay Area is higher than that of the Bay Area as a whole.

Emissions and Air Quality. During periods of high air pollution potential, substantial emissions are all that are required to produce an air quality problem. Figure II-7(C) shows how emissions to the atmosphere from sources in the Bay Area vary during the year. The peak rate occurs during the period of restricted ventilation and highest inversion intensity — summer and early fall.

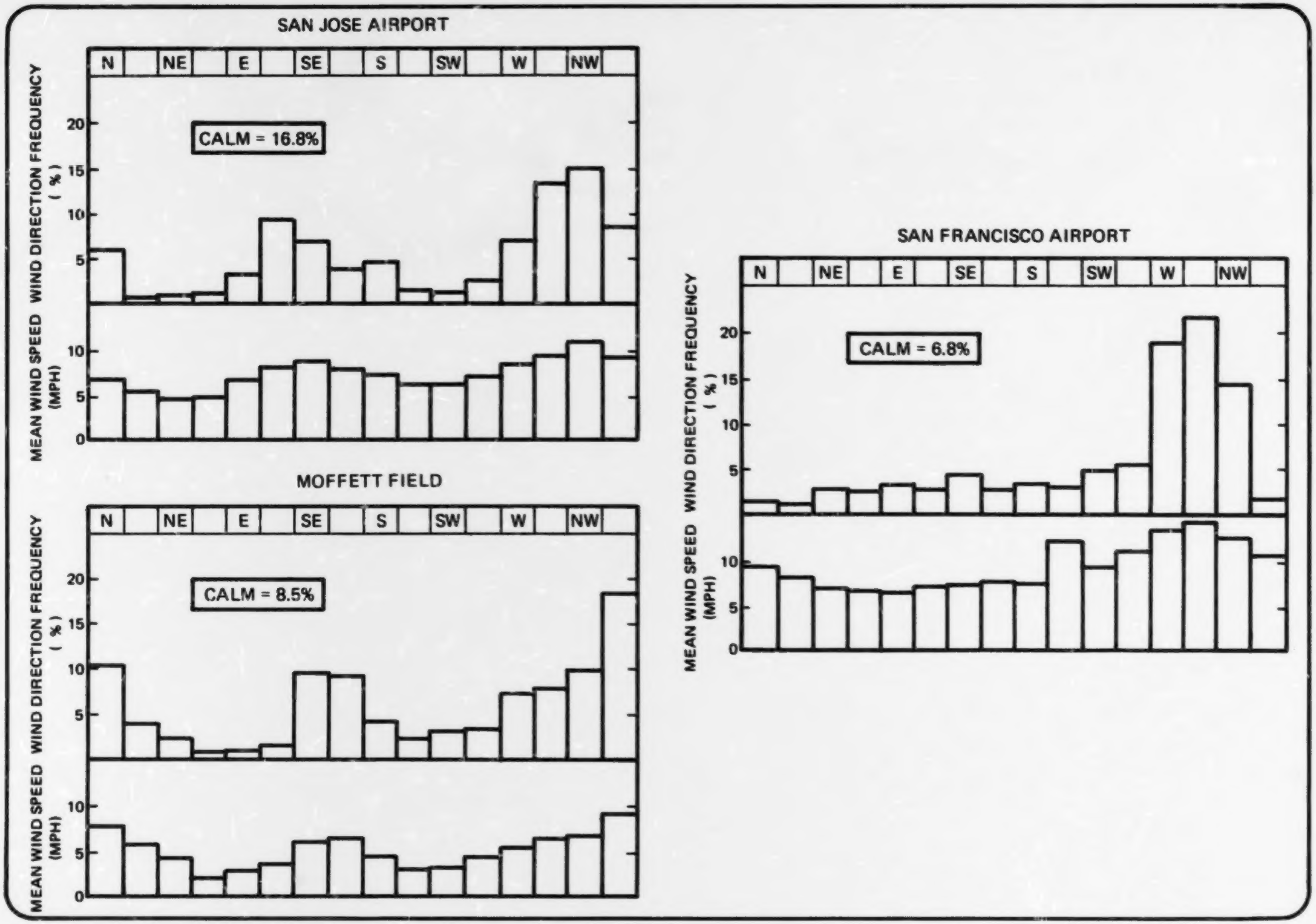
Figure II-8 summarizes the emissions in the Bay Area as to type of emission, source, and geographical distribution. For an average daily load of 5,760 tons, motor vehicles (mostly passenger cars) account for 45 percent of the total. Transportation as a whole accounts for 55 percent. Santa Clara County is responsible for about one-fourth of the total daily emissions.



SOURCE: Climatography of the United States, No.86-4, decennial census of United States Climate, climatic summary of the United States, supplement for 1951 through 1960, California

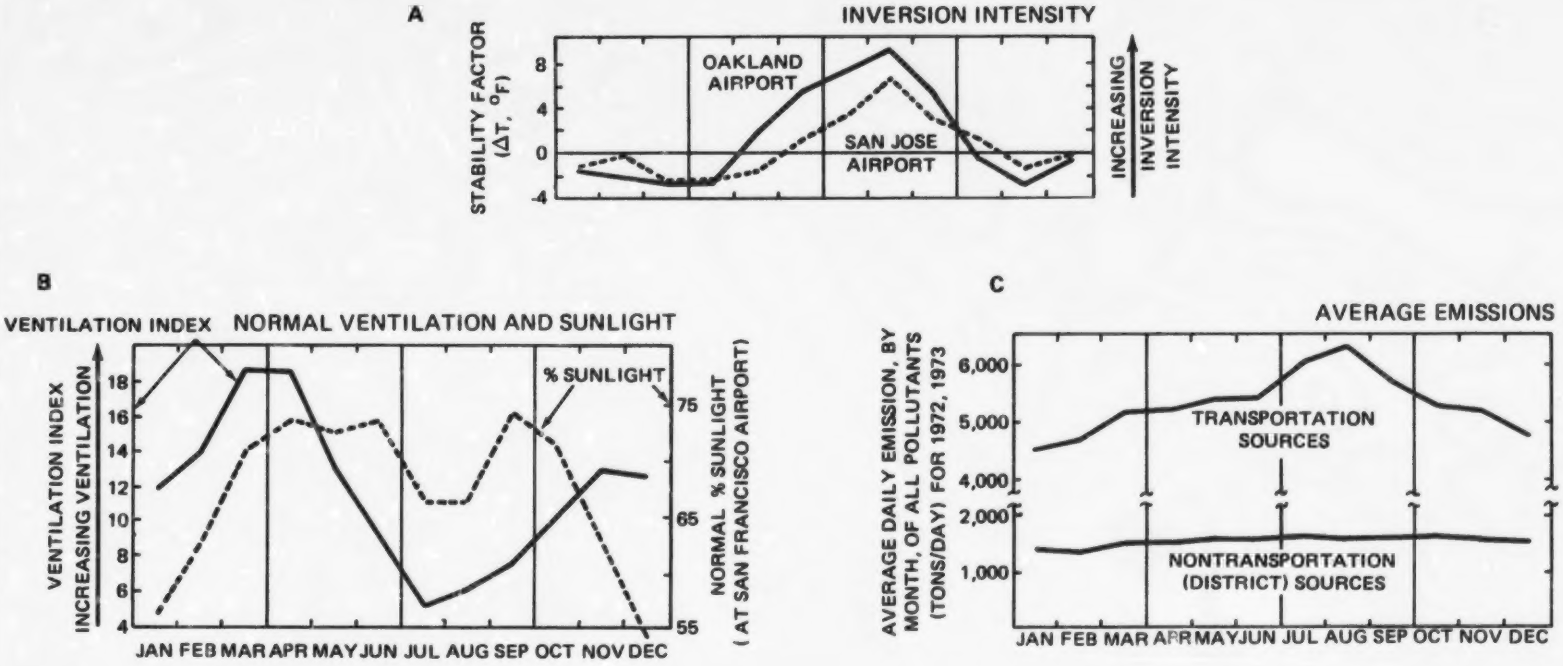
Figure II-5

AVERAGES OF METEOROLOGICAL PARAMETERS MEASURED AT SAN JOSE AND SAN FRANCISCO AIRPORTS



SOURCE: Aviation Effect On Air Quality – San Francisco Bay Region, Regional Airport Systems Study, Association Of Bay Area Governments, Bay Area Air Pollution Control District, February 1971

Figure II-6
ANNUAL WIND DIRECTION FREQUENCY AND MEAN WIND SPEED BY DIRECTION



NOTES:

(A) The Ventilation Index is derived from Oakland radiosonde data and represents ventilation on a 1 to 5 scale of increasing intensity, with air flow direction at the 1,000 millibar level. The average of monthly normals for 1972, 1973, and 1974 are plotted. Normal sunlight taken from the National Weather Service Station in San Francisco. Ample sunlight is necessary for the smog reaction to proceed. Ventilation measures the amount of air available to dilute emissions.

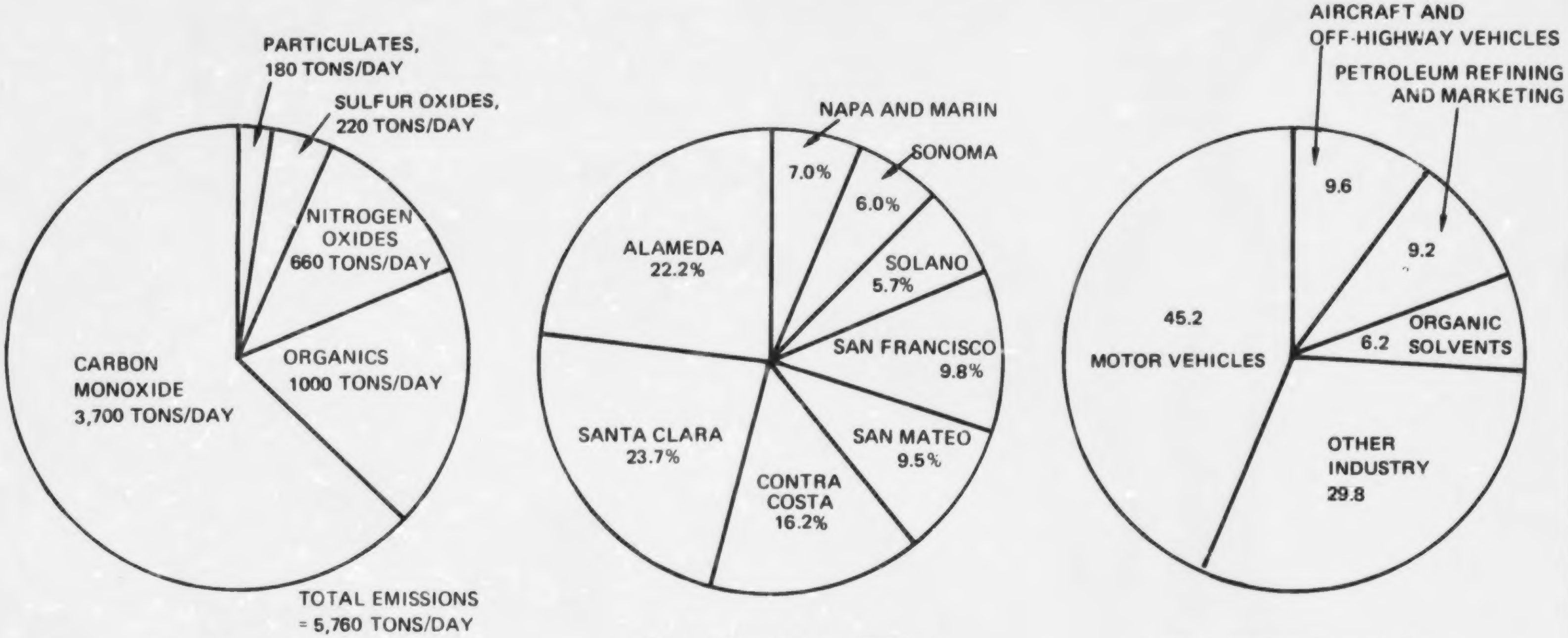
(B) Inversion intensity or strength approximated by the stability factor which is the temperature (°F) at 2,000 feet minus that at the surface. Vertical mixing (necessary to disperse smog) decreases with the algebraic value of the stability factor.

(C) The contribution of transportation sources (mostly automobiles).

SOURCE: Bay Area Air Pollution Control District, 1972, 1973 Emission Inventories and Contaminant and Weather Summaries, monthly 1972–1974; Updated Through 1975.

Figure II-7

PROFILE OF AIR POLLUTION IN THE SAN FRANCISCO BAY AREA



DISTRIBUTION OF EMISSIONS BY TYPE

DISTRIBUTION OF EMISSIONS BY COUNTY

DISTRIBUTION OF EMISSIONS BY SOURCE

STATISTICS – 1975

	BAY AREA	SANTA CLARA COUNTY
POPULATION	4,758,000	1,900,000
MOTOR VEHICLES	3,207,000	–
VEHICLES PER 100 PEOPLE	67	–
LAND AREA (MILES^2)	5,601	1,300
WATER AREA (MILES^2)	493	12
TOTAL AREA (MILES^2)	6,094	1,312

SOURCE: BAY AREA AIR POLLUTION CONTROL DISTRICT, 1975 EMISSION INVENTORY

Figure II-8
EMISSIONS PROFILE FOR THE SAN FRANCISCO BAY AREA 1975

Air Quality in the Bay Area. The quality of the air in the Bay Area, as measured against applicable air quality standards, is not good. During 1976, the oxidant standard was exceeded on 64 days in the Bay Area as a whole and on 32 days in San Jose. During 1976, all standards were exceeded at least once.

Table II-4 summarizes air quality in terms of the number of days air quality standards were exceeded in the Bay Area during 1976. Emphasis is placed on BAAPCD stations located in the South Bay. The days on which standards were exceeded are not distributed evenly throughout the year but concentrate during May through October.

Air Impacts of Wastewater Disposal. As discussed in Section III.6 of this EIR/EIS, disposal is not growth-related for this project. There will be no increase in treatment capacity, and so no secondary air impacts will relate from disposal.

Hydrology

San Francisco Bay is a large, complex estuary covering more than 400 square miles in the midst of a widespread metropolitan area. It is used by millions of people living in surrounding communities for commerce, recreation, fishing, municipal and industrial waste disposal, and as a source of aesthetic pleasure. The northern half of the Bay is a true estuary, having freshwater inflow at the upper end and seawater exchange at the Golden Gate, the Bay's only access to the open ocean. The combined flow of the Sacramento and San Joaquin Rivers, one of the largest river systems in the United States, passes through the upper part of the Bay on its way to the Golden Gate.

San Francisco Bay south of the Bay Bridge does not enjoy a similar, normal estuarine flushing pattern because no large freshwater inflow exists in the southern half of the Bay. Instead, South San Francisco Bay is dependent for the most part on water entering from the rest of the estuary system for flushing and mixing (Selleck et al., 1966; McCullock et al., 1970).

Table II-4

NUMBER OF DAYS AIR QUALITY STANDARDS
EXCEEDED AT SELECTED STATIONS DURING
1976(1)
(Contaminant and Weather Summaries,
Monthly 1976
Bay Area Air Pollution Control District)

	District	Fremont	San Jose	Gilroy	Sunny-vale	Redwood City
Oxidant	64	21	32	30	22	16
NO_x	8	2	3	0	4	0
SO_2	2	0	0	0	0	0
CO	69	1	61	0	14	10
TSP	49	17	16	11	8	12

Notes:
(1) Air Quality Standards applicable to Bay Area:
- Oxidant 0.08 ppm for 1 hr
- NO_x 0.25 ppm for 1 hr
- SO_2 0.50 ppm for 1 hr or 0.04 ppm for 24 hr
- CO 40 ppm for 1 hr or 9 ppm for 8 hr
- TSP (Total Suspended Particulates) 100μg/m^3 for 24 hr

In this report, Lower Bay refers to that portion of the Bay between the San Mateo Bridge and the Dumbarton Bridge. South Bay describes that portion of the Bay south of the Dumbarton Bridge. The Central Bay is that portion of San Francisco Bay between the San Francisco-Oakland Bay Bridge and the San Mateo Bridge. These definitions are not completely equivalent to the definitions in the Basin Plan (SWRCB and RWQCB, 1975). The scope of this section is limited to discussions of hydrological characteristics of the Lower Bay and the South Bay.

Tides and currents. Tidal ebb and flow is a major force acting on the hydrological system in the Bay. Two high tides and two low tides occur daily. The mean tidal range at the Golden Gate is about four feet. Tidal effects tend to increase with distance from the Golden Gate, and at the Dumbarton Bridge the mean tidal range is nearly seven feet (CDM Inc., 1972). Using the mean lower-low water (MLLW) datum, the mean tidal range is 5.5 feet at the Golden Gate and 8.5 feet at the Dumbarton Bridge. Considering highest and lowest estimated tidal data, the maximum tidal range at the Dumbarton Bridge is 13.5 feet (U.S. Army Corps of Engineers, personal communication, 1975). The tidal volume at the Dumbarton Bridge, or the difference in volume of the South Bay between mean higher-high water (MHHW) and MLLW, is approximately 1.8 billion cubic feet (Kaiser Engineers, 1969). This large tidal flow is the primary cause of currents in the Bay south of the Bay Bridge.

Current velocity and direction in the Lower Bay have been studied at various times by the U.S. Coast and Geodetic Survey (now the National Ocean Survey), California Department of Water Resources, and the U.S. Army Corps of Engineers. Measurements have been made over a sufficient range of time, meteorological, and tidal conditions to adequately define flow parameters. Velocity measurements have been taken at Dumbarton Bridge and other stations through the full depth of the water column (CDM Inc., 1972). Results indicate that current velocities at the bridge vary from zero to four feet per second and change direction 180° between ebb and flood tides (S.C.S.P. Committee, 1974). At the Dumbarton Strait, tidal velocities are uniform with depth and are not significantly influenced by natural stream inflow even during the rainy months (CDM Inc., 1972). Typical current velocity measurements taken by the Coast and Geodetic Survey during maximum ebb near Dumbarton Bridge are shown in Table II-5. These data show little variation in current velocity throughout the vertical water column.

Tidal current velocities during the entire tidal cycle have also been measured by the Coast and Geodetic Survey. Table II-6 illustrates the typical tidal cycle in the surface water near the Dumbarton Bridge. Tidal flushing is clearly substantial in the narrow strait at the bridge. At points north or south of the bridge, however, tidal current velocities are normally decreased concomitantly with increased Bay width.

Table II-5

VARIATIONS IN MAXIMUM EBB TIDE CURRENT
VELOCITIES NEAR DUMBARTON BRIDGE
(CDM Inc., 1972)

Depth (ft)	Current Velocity (ft/sec)		
	May 11, 1953	May 12, 1953	May 14, 1973
8	2.9	2.9	3.0
20	2.7	2.7	2.5
35	2.4	2.5	3.0

Table II-6

TIMING, DIRECTION, AND DURATION OF TIDAL
VELOCITIES AT DUMBARTON BRIDGE
(CDM Inc., 1972)

Average surface velocity (ft/sec)	Direction	Time
1.9	South	2 hr before max. flood
2.9	South	1 hr before max. flood
3.0	South	at max. flood
2.5	South	1 hr after max. flood
1.5	South	2 hr after max. flood
Slack	—	3 hr after max. flood
1.7	North	2 hr before max. ebb
3.0	North	1 hr before max. ebb
3.4	North	at max. ebb
2.9	North	1 hr after max. ebb
1.7	North	2 hr after max. ebb
0.5	North	3 hr after max. ebb

Circulation and Dispersion. Tributary inflow to the South Bay is negligible when compared to tidal exchange. Tidal currents are, therefore, the driving force for net circulation in the Bay. Wind energy, which exerts a steady, directional pressure, as opposed to the ebb and flow movements of tides, is not stressed in the literature as a major driving force for circulation in the Lower Bay, although it certainly influences surface drift (Conomos et al., 1971). In enclosed bodies of water, wind energy is normally the primary cause of circulation patterns. In San Francisco Bay, instantaneous wind currents must be less than tidal currents, but net wind drift could be significantly greater than net tidal currents and may be a driving force for water circulation in the Bay.

Experiments with surface drifters, bottom drifters, and dye tracers have established a net circulation pattern of flow in the Bay (Hydroscience, 1972; Consoer-Bechtel, 1972). Net circulation south of the Bay Bridge is considerably greater than the total volume of freshwater input would suggest. Average net flow velocities over a complete tidal cycle are illustrated in Figure II-9 (Hydroscience, 1972). From the net velocities, a circulation model has been developed by the California Department of Water Resources. The net circulation pattern for the entire Bay is presented in Figure II-10 (California Department of Water Resources, 1972).

In general, the circulation indicated by the model is in a counterclockwise pattern in the Lower Bay. The circulation trends southward along the main navigation channel on the western side of the Bay and northward in the shallower eastern areas. In the deep navigation channel, the net flow is estimated to range up to 10,000 cubic feet per second (cfs) southward during the summer (SCSP Committee, 1974). Pollutants discharged to the deep water of the navigation channel may therefore have higher residence times than pollutants discharged to shallower water in the eastern portion of the Bay, where the net direction of flow is northward toward the Golden Gate. Wastewater discharged directly north of Dumbarton Bridge would tend to circulate toward the eastern shore

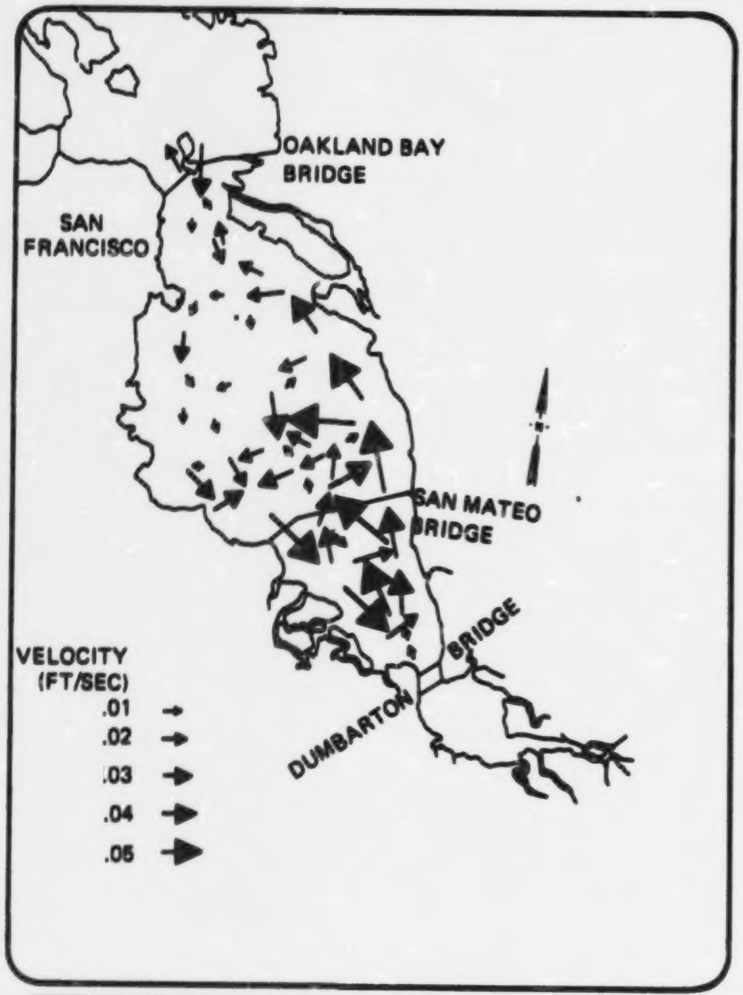


Figure II-9
INTERTIDAL VELOCITIES FROM HYDRODYNAMIC MODEL (HYDROSCIENCE, 1972)

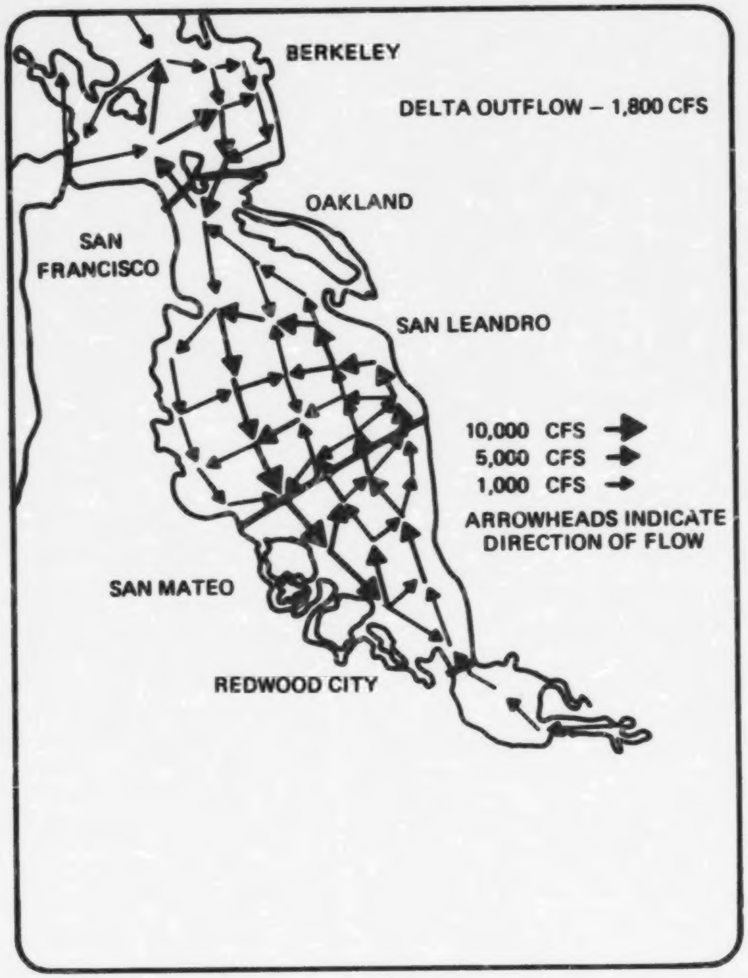


Figure II-10
NET CIRCULATION PATTERN FOR SAN FRANCISCO BAY

and then north toward the Bay Bridge. North of the San Mateo Bridge, a net westerly crosscurrent exists that might tend to temporarily retain water in a large counterclockwise eddy in the Lower Bay.

The circulation patterns in Figure II-10 indicate that while a good deal of mixing occurs within the Lower Bay, relatively little interchange occurs between the water masses north and south of the Bay Bridge. It is important to note that Figures II-9 and II-10 illustrate net current and circulation patterns, but do not imply instantaneous flow of surface or bottom waters at any given time. Instantaneous flows are often greater than net flows and may move in directions other than that indicated in Figure II-9. Dye tracer studies have tended to support these general circulation patterns, however, and have shown a substantial degree of mixing and dispersion north of the Dumbarton Bridge within a few tidal cycles (Consoer-Bechtel, 1972).

While tidal action is primarily responsible for mixing of water masses within the Lower Bay, other observations indicate that flushing of that area is affected by freshwater flow from the Sacramento River. Measurements of Sacramento River discharge and flushing below the Bay Bridge indicate that soluble waste materials are removed from the Lower Bay largely during periods of high river discharge (McCullock et al., 1972). This is apparently due to massive surges of low salinity river water into the Lower Bay during heavy flow. The low salinity water is then subsequently mixed throughout the Lower Bay by tidal action. This system of indirect flushing of the waters of the Lower Bay is apparently greater than the flushing action of wastewater discharge and tributary runoff combined (McCullock et al., 1972).

Fewer data are available concerning water circulation south of the Dumbarton Bridge. In the vicinity of the bridge, the Bay narrows to a width of approximately 6,200 feet at a mean higher-high water and has a maximum depth of about 40 feet. At mean lower-low water, the width of the strait narrows to approximately 3,300 feet (Hydroscience, 1972). As shown in Tables II-5 and II-6, a considerable tidal current sweeps through the narrow strait, and tidal action is probably responsible for nearly all water exchange in the shallow South Bay. An average tidal exchange of 2,000 cfs has been estimated at Dumbarton Bridge, or about five percent of the tidal prism at each tidal cycle (SWRCB, personal communication, 1978). There is no evidence to indicate that freshwater surges from the Sacramento River penetrate this far south, and the only continuous source of terrestrial fresh water is wastewater discharge (Hydroscience, 1972). Natural freshwater runoff into the south Bay is seasonal and is generally negligible during the dry summer season.

Mean annual stream discharge to the South Bay from both urban and nonurban sources is about 350 cfs (Kaiser Engineers, 1969), and nearly all of this occurs during the rainy winter months. Projections of total wastewater discharge to the South Bay for 1980, assuming the disposal project is not operational, indicate a mean annual wastewater inflow of about 168 million gallons per day, or 260 cfs, of which approximately 230 cfs will result from SBDA discharges (Consoer-Bechtel, 1972) and the remaining 30 cfs will result from other municipal dischargers such as the Union Irvington and Union Newark plants. Wastewater discharge apparently makes up approximately 40 percent of the total freshwater inflow to the South Bay on an annual basis and nearly 100 percent during the summer months.

Although, on the average, yearly evaporation exceeds yearly precipitation on the South Bay surface, the Department of Water Resources (DWR) circulation model indicates a net northward outflow of water through Dumbarton Strait (Figure II-10), apparently due to a combination of wastewater discharge and tributary runoff during the winter rainy season. The theoretical southward water flow due to net evaportation from the South Bay is approximately equal to 1,000 cfs (Hydroscience, 1972). Runoff from the surrounding watershed must compensate for this evaporative loss in the DWR model.

On the other hand, published data suggest a net annual inflow to the South Bay through the Dumbarton Strait. Using a mean annual stream discharge of 350 cfs (Kaiser Engineers, 1969) and a projected 1980 total wastewater flow of 260 cfs (Consoer-Bechtel, 1972) as the sole freshwater inputs to the South Bay, the net mean water loss from the surface of the South Bay is 390 cfs. Although this rough approximation differs from the DWR model prediction, it appears to be more realistic. It should be pointed out that this net water loss is relatively small when compared to the nearly 2 billion cubic feet of water flowing in and out of the South Bay during each tidal cycle. Dispersion in the South Bay is still poor, however, as water quality attests.

Water Quality

San Francisco Bay is a complicated estuarine system where fresh and saline waters freely intermix. A variety of municipal, industrial, and agricultural wastes from sources throughout the drainage basin has been discharged into the Bay for years. The complex nature of the Bay system and its long-term use as a wastewater sink have combined to create water quality problems in portions of the Bay, especially those areas receiving inadequate freshwater flushing.

A comprehensive investigation of water quality in San Francisco Bay was carried out by the University of California in the early 1960's. The resulting study report (University of California, 1966) remains the most thorough and complete synopsis of water quality in the Bay (Table II-7). The California State Water Resources Control Board (SWRCB and RWQCB, 1974) has recently summarized and evaluated additional data in its *Water Quality Control Plan* (1975). The following discussions of overall water quality and individual chemical parameters have been drawn from material in these two reports, as well as from data in the files of the Regional Water Quality Control Board.

As shown in Table II-7, the Lower and Central Bays have relatively good water quality, mainly because of the flushing effect of fresh water from the Sacramento River. The South Bay, on the other hand, has poor water quality because of inefficient tidal flushing and the small inflow of surface fresn water, and particularly because it has received wastewater discharges for many years. As a result, dissolved materials in the South Bay have a relatively high residence time, and the southernmost tip of the South Bay has the poorest water quality in the Bay system. Except during periods of heavy rainfall, there is little freshwater inflow other than wastewater discharge, and during the summer, evaporation exceeds inflow. It has been estimated that the waters of the South Bay consist of up to 50 percent wastewater during dry weather (BASSA, 1975). Near the Dumbarton Bridge, this percentage was estimated to be about 10 percent by BASSA, still very high for a natural body of water.

It is this lack of systematic flushing in the South Bay that allows pollutants to be retained in the water for long periods of time. In the extreme southern region, the biological oxygen demand (BOD) of Bay water has been observed to be higher than 48 mg/l, or essentially that of treated wastewater. Dissolved oxygen (DO) levels of less than 1 mg/l have been recorded (University of California, 1966). Such unfavorable oxygen conditions, when they occur, indicate a very unhealthy aquatic habitat. In addition, numbers of coliform bacteria have been high.

Along a longitudinal traverse from the Lower Bay southward, the quality of the aquatic environment gradually declines. This trend is shown in Table II-7. Except for localized conditions of poor water quality around waste discharge effluents and port facilities, the Lower Bay shows few indications of the general environmental degradation often seen in the extreme South Bay (SWRCB and RWQCB, 1974). Since the comprehensive studies by the University of California (1966) in the last decade, conditions in the South Bay have improved (Table II-8). BOD loadings have decreased and dissolved oxygen concentrations in the Bay water have increased since completion of secondary treatment facilities in San Jose. Coliform bacteria have also decreased in number throughout most of the Bay in recent years. On the other hand, toxicity of Bay waters appears to be increasing somewhat, especially in areas adjacent to waste discharges. The toxicity is apparently due to increased chlorination and greater loads of ammonia and heavy metals in the discharges (SWRCB and RWQCB, 1974).

Table II-7

SUMMARY OF WATER QUALITY CHARACTERISTICS OF CENTRAL AND SOUTH SAN FRANCISCO BAY, 1958-1964

(University of California, 1966)

Constituent Property		South(1) Bay	Lower(2) Bay	Central Bay
Temperature (°C)	Low(3)	9.3	10.7	10.1
	Mean	16.3	14.8	13.5
	High(4)	24.0	21.0	19.0
Secchi disk transparency (feet)	Low	0.5	0.5	1.0
	Mean	1.9	3.5	4.6
	High	4.0	8.5	9.0
pH	Low	7.2	7.8	7.6
	Mean	7.6	7.95	7.9
	High	8.0	8.1	8.1
Suspended solids (mg/l)	Low	15	8	5
	Mean	55	29	15
	High	164	56	38
Chlorosity (g/l)	Low	9.5	13.5	15.5
	Mean	15	16	16.5
	High	19	17	18
Dissolved oxygen (mg/l)	Low	0.7	7.0	6.5
	Mean	5.1	7.4	7.3
	High	8.3	8.5	8.2
Dissolved oxygen saturation (%)	Low	9.3	81	80
	Mean	55	90	84
	High	92	99	92
Biochemical oxygen demand (mg/l)	Low	0.5	0.4	0.4
	Mean	10	0.8	0.7
	High	48	1.5	1.0
Ammonia nitrogen (mg/l)	Low	-	0.06	0.05
	Mean	3	0.12	0.15
	High	11	0.21	0.48
Nitrate nitrogen (mg/l)	Low	0.05	0.08	0.10
	Mean	0.35	0.34	0.24
	High	1.1	0.55	0.35
Reactive phosphate (mg/l)	Low	-	0.3	0.2
	Mean	-	0.5	0.32
	High	-	0.8	0.4
Dissolved silica (mg/l)	Low	2.3	2.9	1.4
	Mean	8.7	5.4	3.6
	High	16	7.7	5.5
Coliform bacteria (MPN/100 ml)	Low	10	10	200
	Mean	2×10^4	5×10^2	1×10^3
	High	3×10^4	3×10^4	6×10^4
Total microplankton (cell/l)	Low	1.2×10^3	3.0×10^3	6.6×10^3
	Mean	1.4×10^4	1.0×10^4	3.7×10^4
	High	3.8×10^5	1.5×10^6	6.7×10^5
Total zooplankton (org/cu m)	Low	500	5,400	3,000
	Mean	7,000	8,800	7,800
	High	40,000	12,000	15,000

Notes:
(1) South of Dumbarton Bridge.
(2) Between Dumbarton Bridge and the San Mateo Bridge.
(3) Low = 5 percentile value.
(4) High = 95 percentile value.

Table II-8

COMPARISON OF SERL(1) WATER QUALITY DATA AND RECENT (1975-1977) MONITORING STATION DATA(2)

	Stations(3)					
Parameter	C3	16	C6	15	C7	14
DO(mg/l)	4.0	1.1	4.4	2.0	5.0	3.0
NH_4-N(mg/l)	13.9	10.0	7.3	8.0	3.5	2.5
NO_3^--N(mg/I)	0.9	0.2	1.3	0.2	1.2	0.5
PO_4(total) (mg/l)	19.2	10.3	11.3	5.9	6.9	5.5
Secchi Disc (in.)	10.1	9.6	12.5	10.8	15.6	14.4

Notes:

(1) Sanitary Engineering Research Laboratory, University of California, 1966.

(2) Appendix E.

(3) Stations 14, 15, 16 in Coyote Creek (from north to south) for SERL (1966). Stations C7, C6, C3 in Coyote Creek (from north to south) for San Jose/Santa Clara are in approximately the same location as the SERL stations. All are South Bay stations.

The following discussion of individual parameters emphasizes present water quality of the Lower and South Bays. Most recent available data have been obtained from the Regional Water Quality Control Board. This material is presented in Appendices D and E and summarized in the text wherever appropriate. Supplementary water quality field studies are shown in Appendix H.

Temperature. Water temperature varies in a seasonal cycle at all points within the Bay. In general, seasonal variations are smallest near the Golden Gate and increase with distance up and down the Bay as the moderating influence of the ocean decreases (Figure II-11). Although yearly variations occur, water temperature extremes in the South Bay are about 5 to 10°C in late winter and 20 to 25°C in late summer. Water temperatures in the Bay system are apparently controlled exclusively by natural phenomena. Available data show no significant changes in background or general ambient temperature in any part of the Bay (SWRCB and RWQCB, 1974).

Transparency. Water transparency is normally low in the Bay. In general, the water clears slightly as the sampling stations are moved closer to the Golden Gate Bridge, but it still remains relatively turbid. Typical Secchi disc readings are 4 to 5 feet in the Central Bay, 2 to 3 feet in the Lower Bay and 1 to 2 feet near Dumbarton Bridge (University of California, 1966). Secchi disc transparencies are often less than one foot in the South Bay (Table II-8) due to the abundance of suspended silts and clay particles from the tidal flats, but there is recent evidence of improvement in transparency in the extremities of the South Bay.

pH. The pH is relatively constant throughout the Bay, ranging from about 7.3 to 8.0. Values below 7.5 occur mainly in the extreme South Bay. In the Lower Bay, including the Basin Plan Alternative discharge area, pH values range from 7.7 to 8.0. In the extreme South Bay, a moderate seasonal pH cycle has been reported with values of about 7.8 occurring in the summer and 7.4 in the winter (University of California, 1966). Recent data collected in Coyote Creek, however, show no pronounced seasonal pH trends, although values continue to range primarily between 7.4 and 7.8.

Suspended Solids. Suspended solids vary widely throughout the Bay, and, as with several other parameters, concentrations change as a function of distance from the Golden Gate. From about 10 mg/l in the Central Bay, mean values increase to about 70 mg/l near Coyote Creek in the South Bay. Although individual concentrations vary widely, mean values of 50 to 60 mg/l suspended solids are typical of water near the Dumbarton Bridge

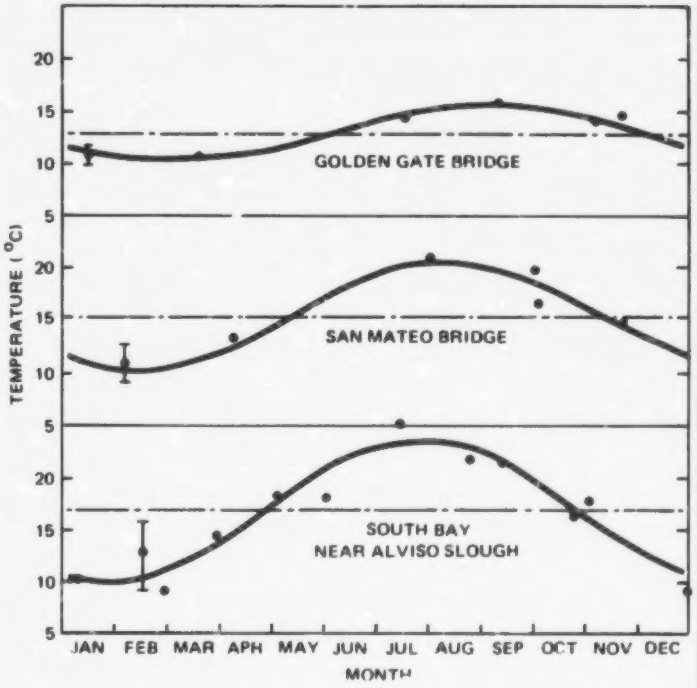


Figure II-11

SEASONAL VARIATION OF WATER TEMPERATURE AT SEVERAL LOCATIONS IN SAN FRANCISCO BAY (UNIVERSITY OF CALIFORNIA, 1966)

(University of California, 1966). Suspended solid concentrations should continue to decrease as wastewater treatment facilities around the Bay continue to be upgraded.

Salinity. Salinity is a complex function of runoff, evaporation, and tidal flux. Horizontal and vertical gradients are seen throughout many parts of the Bay, with the highest salinities observed at the Golden Gate. Because of the minimal freshwater inflow to the southern portion of the Bay, salinities remain generally high in the Lower and South Bays, and vertical gradients are not pronounced during most of the year.

Mean yearly salinity values are about 27 to 29 parts per thousand (ppt) throughout the Lower Bay and South Bay as far as Alviso Slough. (Seawater, by comparison, has a salinity of about 34 ppt.) Near the mouth of Coyote Creek, the mean value drops to about 22 ppt. A seasonal cycle is evident below the Dumbarton Bridge with chloride concentrations averaging 20 percent below the yearly mean in early spring and 20 percent above the mean in early autumn. The amplitude of the cycle decreases gradually toward the Golden Gate.

In the sloughs bordering the South Bay, salinities are lower than in the Bay water. In general, salinities in the sloughs vary seasonally as a function of precipitation and runoff. Some areas, however, retain low salinities year-round. This is especially true of waterways such as Artesian Slough and, to a lesser degree, Guadalupe Slough, which receive wastewater effluents from existing treatment facilities. Because of the steady flow of fresh water, such waterways are among the few freshwater habitats in the South Bay. The most notable example is Artesian Slough, the source of which is wastewater effluent from the San Jose/Santa Clara water pollution control plant. The resulting manmade habitat supports populations of freshwater and estuarine wildlife, protected by dikes from the saline waters of salt evaporators. This environment is fragile and depends on continuous nonsaline wastewater flow for its existence.

Dissolved Oxygen and Oxygen Demand. Maintaining high concentrations of dissolved oxygen (DO) in Bay waters are of great importance to good water quality. Persistent or intermittant reduction of DO levels can have detrimental effects on fish and other aquatic wildlife. The Regional Water Quality Control Board has established standards that require DO concentrations greater than 5.0 mg/l in San Francisco Bay, with an annual median in excess of 80 percent saturation, except where natural factors cause a lower concentration. DO levels below 5 mg/l are considered harmful for Bay fishes. Levels as low as 2 mg/l can result in rapid mortality of fish and other aquatic animals. Anaerobic conditions are lethel and may result in long-term impairment of habitat as well as an aesthetically displeasing environment (SWRCB and RWQCB, 1974).

Throughout most of San Francisco Bay, DO levels are quite high. The entire Lower Bay as far south as the Dumbarton Bridge has DO levels that are consistently higher than 7.0 mg/l, with minimum values greater than 6.0 mg/l and saturation values normally greater than 85 percent. In the South Bay, however, DO concentrations have historically been less favorable. South of the Dumbarton Bridge, the Bay waters often do not meet the RWQCB standards, especially in the sloughs and neighboring areas receiving wastewater discharges (Appendix E; City of San Jose, 1973). Although some improvements of DO levels have occurred since the recent implementation of local secondary waste treatment facilities, the South Bay still has mean DO values of only about 5 mg/l and low DO concentrations of less than 1 mg/l (Table II-8; Appendix E). As would be expected, biological oxygen demand (BOD) values correlate inversely with DO levels in the water. The mean BOD in the lower Bay is about 1 mg/l. In the South Bay, however, the mean BOD is 10 mg/l in the open water, with much higher values common in the sloughs receiving wastewater. The BOD loading in the wastewater is a prime cause of oxygen depletion in the South Bay water. Heavy BOD loadings and resulting DO depletion in the extreme South Bay are especially critical during the dry summer months when treated wastewater makes up virtually all of the freshwater inflow (University of California, 1966; SWRCB and RWQCB, 1974; see Appendices D and E).

The secondary treatment at the San Jose/Santa Clara plant now removes a significant portion of the carbonaceous oxygen demand, but the oxidation of nitrogenous organic matter in the effluent, especially ammonia nitrogen, continues to exert a high BOD. Other discharges to the lower South Bay, from both point and nonpoint sources, also contribute to the periodically depressed DO values (Appendix C). As recent trends suggest, DO concentrations should continue to improve in the South Bay as local dischargers continue to upgrade effluent quality during the next decade (Table II-8). At present, DO saturations of 30 to 50 percent occur in most of the shallow sloughs and channels around the periphery of the South Bay (SWRCB and RWQCB, 1974). During the wet winter months, DO levels are higher than those observed during the dry period. North of Coyote Creek, concentrations are generally within 2 mg/l of saturation and gradually increase toward the Dumbarton Bridge.

Nutrients. Any chemical constituent necessary for the growth of aquatic plants can be considered a nutrient. The major plant nutrients are nitrogen, phosphorous, and carbon. Other parameters, including silica, various trace elements, and vitamins, are also required by most aquatic plants. Partly because of sewage effluents, nutrients are generally in plentiful supply in the Bay waters. Nitrogen and phosphorous compounds normally exhibit concentration patterns similar to BOD, with relatively low values in the Lower Bay increasing to sharply higher concentrations in the extreme South Bay. Available data for the South Bay generally suggest that levels of nitrogen nutrients are somewhat higher now than when the University of California (1966) study was conducted, and that total phosphorus levels have risen appreciably over the past 10 years (Appendix D).

The University of California reported mean and maximum ammonia nitrogen concentrations of 3 mg/l and 11 mg/l, respectively, in the South Bay. In recent years, receiving waters near the Sunnyvale water pollution control plant discharge have exhibited a similar range of concentrations, but a lower overall mean of about 2.5 mg/l (Appendix D). Similarly, in the extreme South Bay, except for poor water quality areas immediately adjacent to waste discharge locations (e.g., Station C3, 16 in Table II-8), mean ammonia nitrogen concentrations have varied within 1 mg/l of values determined in the 1966 University of California study (Table II-8). Given that most sewage treatment facilities have been upgraded, the open waters of the Lower Bay now probably contain less ammonia than the 0.1 mg/l reported in 1966, although recent studies (DWR, 1975 as related by RWQCB personal communication) have reported ammonia levels on several occasions above 2 mg/l in the South Bay. An increase in nitrate nitrogen concentrations from a mean value of 0.35 mg/l (University of California, 1966) to about 1.0 mg/l (Appendix D; Table II-8) has also been evident.

The concentration of phosphorous compounds is also high in the South Bay. Values of total phosphate as high as 10 m/gl were reported in the extreme southern end of the Bay in 1966, with mean values of 2 to 3 mg/l in the South Bay and less than 1 mg/l in the Lower Bay. More recent data indicate mean total phosphate concentrations between 4 and 5 mg/l near the Sunnyvale water pollution control plant discharge (Appendix D) and between 7 and 11 mg/l in the main channel of Coyote Creek in the extreme South Bay (Table II-8). Most of the total phosphate is dissolved inorganic phosphate. As a result, dissolved phosphate levels are generally only slightly lower than total phosphate values. Phosphate concentrations in the South Bay are very high relative to most waters.

Dissolved silica is abundant in the Bay waters, with values averaging about 5 mg/l in the Lower Bay and 9 mg/l in the South Bay. Silica is a more conservative nutrient that is plentiful in seawater. Dissolved silica values vary slightly throughout the year much like chloride concentrations. Carbon is also very plentiful in all Bay waters as dissolved carbon dioxide as well as dissolved bicarbonate ion. Other elements required in trace amounts such as iron, magnesium, and sulfur are present in the San Francisco Bay system in relative abundance. Vitamins and essential organic substances are also present but their status has not been well defined.

All important plant nutrients occur in the south San Francisco Bay in such abundant quantities that they are not considered to be factors which limit algal growth. That is, the existing nutrient concentrations would support higher levels of algal biomass if all other growth limiting factors were favorable. At present, light availability appears to be the principal factor limiting algal growth in much of the turbid Bay waters. In South Bay waters, natural turbidity is apparently high enough most of the time to control the level of algal growths, even where concentrations of phosphates, nitrates, and other nutrients are very high (SWRCB and RWQCB, 1974).

Chlorophyll. On occasion, areas of San Francisco Bay do experience excessive growths of algae. These algal blooms often occur in portions of the North Bay, although the South Bay, especially the southern sloughs, occasionally has algal problems. Algal concentrations greater than 4 million cells per liter have been observed in portions of the South Bay, (Consoer-Bechtel, 1972). As a measure of algal biomass, a water quality objective of 50 μg/l of chlorophyll a has been proposed by the Regional Water Quality Control Board as the upper limit for algae in the Central Bay. The suggested limit is based primarily on aesthetic considerations. Data collected in the South Bay in 1971 showed peak chlorophyll a values exceeding 250 μg/l in Coyote Creek and adjacent sloughs. In contrast, chlorophyll a measurements at Dumbarton Bridge were normally below 10 μg/l, although a maximum value of 31 μg/l has been observed (SWRCB and RWQCB, 1975).

Coliform Bacteria. The concentration of viable coliform microorganisms in water is used as a measure of bacterial contamination caused by domestic waste discharges. As shown in Table II-7, coliform bacterial counts expressed as most probable number (MPN) are highly variable throughout the Bay. The South Bay normally has the poorest bacteriological quality. Like other contaminants, coliform bacteria levels have improved somewhat during the last few years, although the counts are still often undesirably high. Current prohibitions against commercial shellfishing in the Bay, for example, are based on bacterial contamination of the animals (SWRCB and RWQCB, 1974).

Data comprised of over 300 samples collected near the Sunnyvale discharge point during 1973 and 1974 indicate that the maximum coliform count during this period was 2.4×10^3 MPN/100 ml. Highest counts occurred during the summer months. The mean count was 460 MPN/100 ml in 1973 and 990 MPN/100 ml in 1974. These values show an improvement over the levels of the last decade, due in part to improved treatment facilities. Currently approved treatment levels should contribute to this improvement by further reducing the coliform loading from wastewater discharge.

Oil and Grease. Contamination by hydrocarbon compounds is an important water quality concern in San Francisco Bay. The problem is due in part to minor petroleum spills during fuel transfer operations at dock facilities, but only rarely due to major accidents. Typically, more than half of all petroleum spills are of one barrel (42 gallons) or less, and the cause of such spills is almost invariably human error during transfer operation. Bilge pumping within the Bay is also a known source of oil contamination.

Oil spills, however, are not the major source of hydrocarbons in Bay waters. It has been estimated that over 60 tons of oil and grease are discharged to the Bay each day, primarily in the effluents of municipal waste treatment plants. Oil and grease from municipal discharges are therefore the major sources of hydrocarbons in the Bay (SWRCB and RWQCB, 1974). Data collected in 1973-1974 by South Bay dischargers indicate that typical loadings of oil and grease in wastewater effluents average between 27 mg/l (Sunnyvale) and 39 mg/l (San Mateo) on an annual basis. The Bay waters near the Sunnyvale discharge point contained an average of 11 mg/l of extractable oil and grease.

Recent data collected at the San Jose/Santa Clara water pollution control plant, however, indicate that the effluent from this plant contains significantly lower concentrations of oil and grease. Typical oil and grease loadings at San Jose/Santa Clara range from 1 to 10 mg/l. In approximately 240 samples collected between October 1974 and September 1975, only about 15 samples contained more than 10 mg/l of oil and grease (Belick, personal communication, 1975).

Toxicity. High concentrations of toxic material may cause aberrant behavior or death of aquatic species. Fish kills in San Francisco Bay have sometimes been attributed to the toxicity of municipal or industrial waste dischargers, although the exact nature or identity of the toxic material is often difficult to determine. In recent years, there have been occasional fish kills, but no direct cause-and-effect connection between wastewater toxicity and the kills has been made (Calif. Fish and Game, personal communication, 1978, and SWRCB, personal communication, 1978). Low levels of dissolved oxygen; contamination by pesticides, other toxic organic compounds, heavy metals, ammonia, or petroleum; pH, temperature, or salinity changes; and other problems have been implicated in fish toxicity. The cause of toxicity is poorly defined and open to various interpretations.

The toxicity of wastewaters is often considered only in terms of the survival of indicator fish in bioassay testing. In many cases, the differences are great between lethal concentrations of toxicants and concentrations that permit reproduction and growth. The correlation between bioassay results based on a single test organism, and the actual impact on receiving water biota is further obfuscated by the variety of fish, invertebrate species, and lower food chain organisms found in a receiving water body, each having its own distinct susceptibility to toxicants. In addition, the variability of toxic waste discharges introduces further uncertainty in the quantification of toxic impacts on a receiving water.

Toxicity data are generally reported in terms of a median tolerance limit (TL_m), the concentration that kills 50 percent of the test organisms within a specified time span, usually 96 hours. Most bioassays are thus a measurement of acute toxicity. The step from estimation of the acute toxicity of wastewater on a test species to the quantification of its chronic affects on receiving water organisms cannot be made directly. A certain amount of subjective judgment is necessary. In the last several years, much work on relative toxicity, a unit of measurement developed to reflect the overall effect of wastewater on biota, has been performed in San Francisco Bay. In the rest of the country, however, and in the last four years in California, toxicity research has concentrated on determining the toxic levels of concentrations of specific materials (i.e., heavy metals, pesticides, etc.) on different organisms, and little, if any, work has been pursued on the relative toxicity concept.

While chronic toxicity cannot be precisely quantified, a number of independent investigators have determined the threshold toxic concentrations of municipal wastes and have produced strikingly similar results. The toxicity guideline given in the Basin Plan (SWRCB and RWQCB, 1975) is 40 mml/l (0.04 toxic unit). This was based on work done by Kaiser Engineers. Their analysis was based on a correlation between benthic species diversity and receiving water conservative elements. Threshold effects were noted at a calculated toxicity concentration of 0.04 toxic units in the receiving water. A series of reports prepared by representatives of the Department of Water Resources, Fish and Game, and U. C. Berkeley (SWRCB, 1972) generally supported the toxicity limitation recommended by Kaiser Engineers, as did work by Dr. Horn at SERL (1974 as reported by RWQCB, personal communication, May 1977). Dr. Horn's studies showed that toxicity concentrations above 0.12 toxic units consistently affected aufwuchs(1) growth and that a threshold effect at 0.03 toxic units were often observed. However, the SWRCB (1972) studies indicated that toxicity effects on benthic species diversity, while limiting, may indeed be masked by effects of other parameters such as sediment particle size distribution or salinity, and that decreased toxicity in receiving waters may not result in a detectable change in biotic factors due to these masking effects.

The National Technical Advisory Committee on Water Quality (1968) recommended that the 24-hour average concentrations of toxicants after mixing in a receiving water should not exceed 1/20th of the 96 hour TL_m for degradable, noncumulative substances and 1/100th for conservative, cumulative, or unidentified toxicants. These recommendations are based on wastes in the mid-range of relative toxicity and correspond to receiving water toxicity limits of 0.05 to 0.01 toxic unit, respectively.

Toxicity can be calculated using bioassay results and equations given in the *Tentative Water Quality Control Plan* (SWRCB and RWQCB, 1974). These calculations do not separate the individual causes of mortality in bioassay tests, however, and therefore cannot distinguish between toxicity due to the presence of one or more toxic materials (ammonia, heavy metals, pesticides) and toxicity due to osmotic stress (stress induced by subjecting the test species to waters of higher or lower salinity than its normal range). Since the test species used in bioassays (the three-spined stickleback) is relatively tolerant of variations in salinity (Lagler et al., 1962), for purposes of most calculations, the toxicity units are assumed to be due to the presence of toxic elements.

Bioassay tests of effluent in 1977-78 at the three treatment plants have shown the following ranges of survival:

- Palo Alto, 96 hour survival of 100 percent, if no chlorine residual present (Remmel, personal communication, July 1978).

---

(1) Aufwuchs is a German biological term which refers to organisms, except for large rooted plants, which are attached to a substrate and has a broader meaning than the American term "benthos."

- Sunnyvale, 96 hour survival of 90 to 100 percent; no identified causes of mortality (Somers, personal communication, July 1978)

- San Jose/Santa Clara, 96 hour survival ranging from 13.3 to 100 percent, with a June 1977 to June 1978 average of 80.6 percent; no identified causes of mortality (Belick, personal communication, July 1978. May be due to pulse loadings to sewers.

Dechlorination, nitrification, and other advanced waste treatment being implemented at the three plants may contribute to a decrease in the toxicity reflected by these bioassays. However, advanced waste treatment will not affect toxicity due to heavy metals or other substances not normally removed in the treatment process.

Heavy Metals. Toxic heavy metals, such as cadmium, lead, copper, and mercury, are not only acutely toxic at certain environmental concentrations, but also can be accumulated in the tissues of aquatic animals at less than toxic levels and passed through the food chain. Through biomagnification, predators can then be exposed to much higher than normal concentrations, higher even than those found in the water. While much of the uptake of heavy metals is either from the sediments or through ingestion of food particles, heavy metals are known to occur in wastewater and in solution in Bay waters. The Basin Plan (SWRCB, 1974) reports heavy metal concentrations in the waters of Suisun Bay to be as follows: copper, 100 to 1,400 µg/l; cadmium, 10 to 100 µg/l; lead, 10 to 100 µg/l; zinc, 10 to 500 µg/l; and chromium, 10 to 50 µg/l.

The copper concentrations reported for Suisun Bay are greater than toxic levels of copper citrate reported for tolerant and nontolerant marine ogranisms (Bryan, 1976) by as much as 700 times. Similarly, zinc levels observed in Suisun Bay have been observed to be toxic to marine worms.

The RWQCB (personal communication, May 1978) indicates that the highest concentrations in San Francisco Bay regularly occur below Dumbarton Bridge. It is estimated that about 50 percent of the heavy metal loading from wastewater effluent south of San Francisco is discharged south of Dumbarton Bridge. This corresponds to approximately 52 metric tons a year entering the South Bay, an area which in volume comprises only eight percent of the total Bay water volume south of San Francisco (RWQCB, personal communication, June 1978). Studies by E. H. Smith and Associates for this draft EIR/EIS (Appendix H) indicate heavy metal concentrations as follows: cadmium, 2 to 5 µg/l; lead, 20 to 70 µg/l; zinc, 3 to 116 µg/l; and mercury, 0.2 to 1.2 µg/l. At least the zinc conentrations in Bay waters near Dumbarton Bridge could be acutely toxic to benthic life.

Heavy metal contributions to South Bay by SBDA member dischargers were approximately 49 tons per year in 1976-77. (RWQCB, personal communication, July 1978). These metal loadings will not be affected by advanced waste treatment now approved but may be reduced by source control or industrial pretreatment where feasible. It is not known which portion of the heavy metal loading, shown in Table II-9, is attributable to industry, however; it must be assumed that this loading will continue in the future, regardless of treatment or disposal.

Noise

Background noise levels along the principal conveyance alignment are relatively high due to frequent aircraft flyovers, freeway and street traffic, and industrial operations. In May 1975, an ambient noise survey was conducted by Bechtel in order to measure existing noise levels and to establish baseline conditions to facilitate the assessment of future noise impacts along the Basin Plan conveyance route. Background noise level measurements were made at seven locations along the Basin Plan conveyance alignment (Figure II-12). The seven selected noise monitoring stations are believed to typify existing conditions of the acoustical environment of the study area near noise sensitive areas such as residences, schools, and recreational facilities.

II-9

HEAVY METAL LOADINGS TO SOUTH BAY FROM SBDA, 1976-77

(RWQCB, Personal Communication, July 1978)

Treatment Plant	SJ/SC		PA		SV	
Loading	μg/l	lb/day	μg/l	lb/day	μg/l	lb/day
Arsenic	3.0	2.1	9.1	1.8	2.7	0.4
Cadmium	4.5	3.0	12.0	2.3	1.0	0.1
Chromium	16.0	11.0	21.0	4.1	22.0	2.9
Copper	80.0	55.0	100.0	22.0	50.0	6.5
Lead	38.0	12.0	7.8	1.7	10.0	1.4
Mercury	1.2	0.36	0.4	0.7	0.1	0.15
Nickle	43.0	29.0	56.0	12.0	42.0	5.5
Silver	4.0	2.8	8.8	1.9	7.0	0.9
Zinc	95.0	65.0	85.0	19.0	41.0	5.4

(see footnote, Table II-10). Results of the noise survey are summarized in Table II-10.

The acoustical environment in the area is dominated by two major noise sources: (1) traffic noise from Bayshore and Alviso Freeways, and (2) aircraft noise due to military aircraft flyovers from Moffett Field in Sunnyvale and civilian aircraft flyovers from airports in Palo Alto, San Jose, and San Francisco. Birds also contribute significant amounts of noise at most locations. A complete report of the present noise environment is presented in Appendix F.

II.1.2 BIOLOGICAL ENVIRONMENT

The South San Francisco Bay is a highly complex ecological system composed of a large variety of habitats and associated species. The development of the South Bay margin by man has greatly modified the natural biological setting, altering the number of habitat types and variety of organisms present with an accompanying loss of net biological productivity. The exisiting beneficial uses of the Bay include commercial and sport fishing, recreation, and maintenance of wildlife populations. At this time, low water quality as a result of past and present wastewater discharge practices has restricted full realization of these uses. While it is not known what the full biological potential of the Bay may be, it must be assumed this potential is being restricted by continued discharge of wastewater. Ongoing studies at the California Academy of Science into the history of the biology of the Bay may indicate to what extent this biological productivity is being repressed (SWRCB, personal communication, July 1978). A comprehensive inventory of the plant and animal species for the Bay Area is presented in Appendix G.

Each of the primary habitat types in the South Bay region is described below, and a discussion of habitat types in and adjacent to the study area is presented.

South Bay Habitats

Major habitats represented in the study area include open water, tidal mud flats, salt marshes, salt ponds, dikes and levees, grasslands, fresh and brackish water streams and sloughs, and fresh and brackish water marshes (Figure II-14). These habitats tend to occur in a linear sequence as one moves from the center of the Bay toward and onto the land. This relationship is shown diagrammatically in Figure II-13.

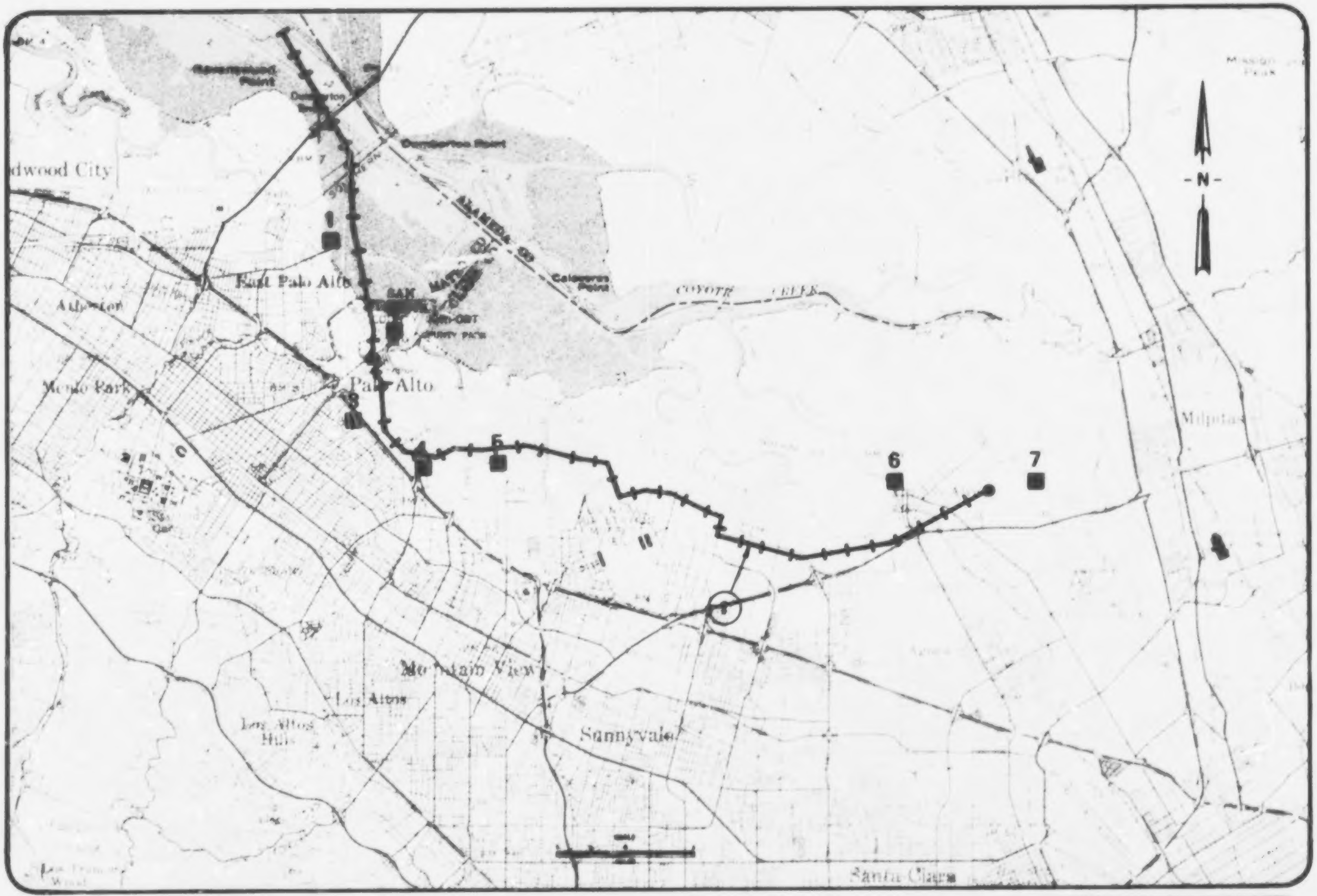
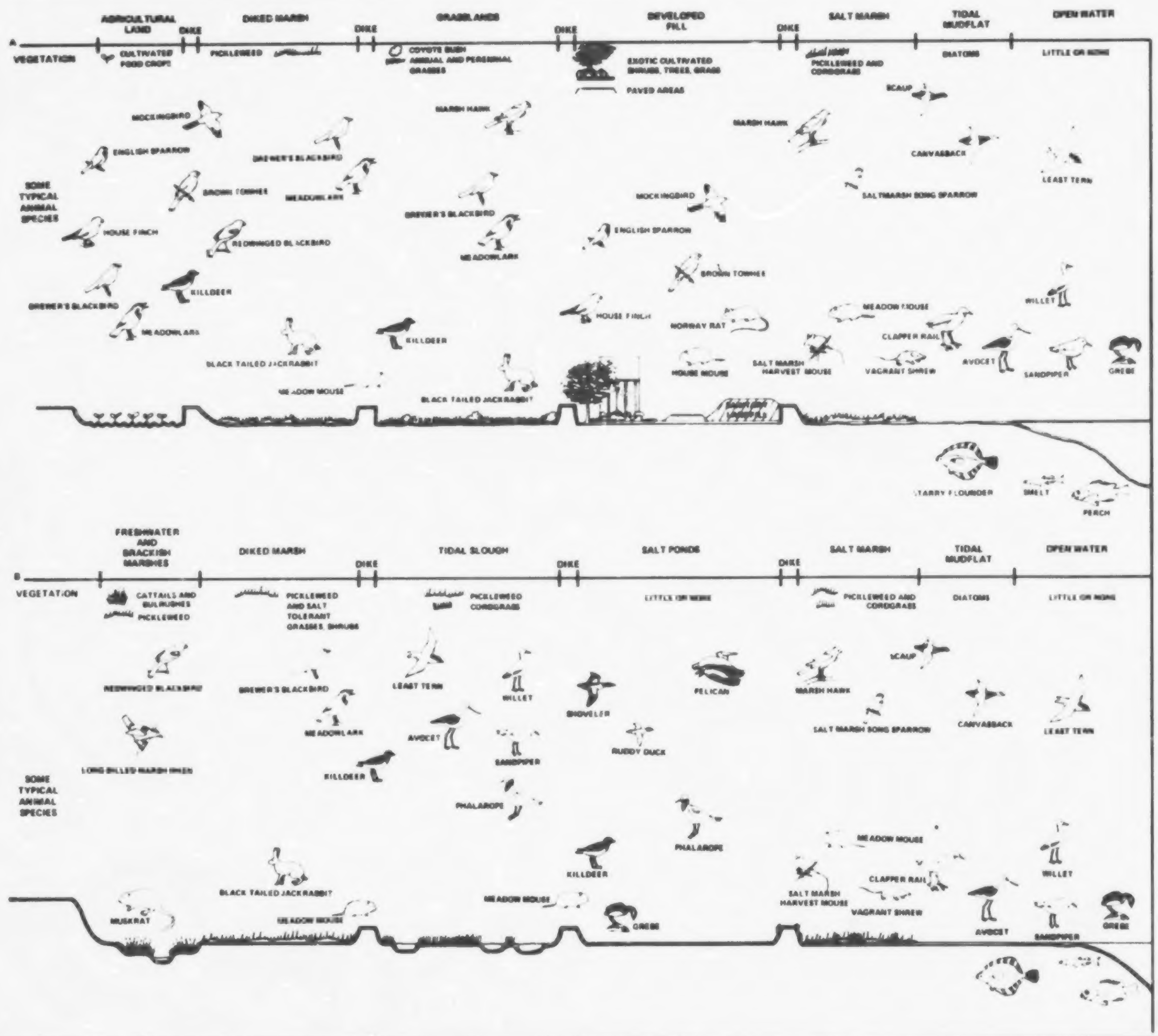

Mission Peak
N
Dumbarton Point
ALAMEDA CO
Calaveras Point
COYOTE CREEK
Redwood City
East Palo Alto
Atherton
Menlo Park
Palo Alto
Mountain View
Los Altos
Los Altos Hills
Sunnyvale
Santa Clara
Milpitas
1
2
3
4
5
6
7
LEGEND
2 ■ Location of Ambient Noise Monitoring Stations
① BASIN PLAN ALTERNATIVE

Figure II-12
NOISE SURVEY


A
AGRICULTURAL LAND
DIKE
DIKED MARSH
DIKE
GRASSLANDS
DIKE
DEVELOPED FILL
DIKE
SALT MARSH
TIDAL MUDFLAT
OPEN WATER
VEGETATION
CULTIVATED FOOD CROPS
PICKLEWEED
COYOTE BUSH
ANNUAL AND PERENNIAL GRASSES
EXOTIC CULTIVATED SHRUBS, TREES, GRASS
PAVED AREAS
PICKLEWEED AND CORDGRASS
DIATOMS
LITTLE OR NONE
SOME TYPICAL ANIMAL SPECIES
MOCKINGBIRD
ENGLISH SPARROW
BREWER'S BLACKBIRD
BROWN TOWHEE
MEADOWLARK
MARSH HAWK
HOUSE FINCH
REDWINGED BLACKBIRD
BREWER'S BLACKBIRD
MEADOWLARK
BREWER'S BLACKBIRD
KILLDEER
MEADOWLARK
BLACK TAILED JACKRABBIT
KILLDEER
MEADOW MOUSE
BLACK TAILED JACKRABBIT
SCAUP
MARSH HAWK
CANVASBACK
LEAST TERN
MOCKINGBIRD
SALTMARSH SONG SPARROW
ENGLISH SPARROW
BROWN TOWHEE
WILLET
MEADOW MOUSE
HOUSE FINCH
NORWAY RAT
CLAPPER RAIL
HOUSE MOUSE
SALT MARSH HARVEST MOUSE
VAGRANT SHREW
AVOCET
SANDPIPER
GREBE
STARRY FLOUNDER
SMELT
PERCH
B
FRESHWATER AND BRACKISH MARSHES
DIKED MARSH
DIKE
TIDAL SLOUGH
DIKE
SALT PONDS
DIKE
SALT MARSH
TIDAL MUDFLAT
OPEN WATER
VEGETATION
CATTAILS AND BULRUSHES
PICKLEWEED
PICKLEWEED AND SALT TOLERANT GRASSES, SHRUBS
PICKLEWEED CORDGRASS
LITTLE OR NONE
PICKLEWEED AND CORDGRASS
DIATOMS
LITTLE OR NONE
REDWINGED BLACKBIRD
BREWER'S BLACKBIRD
LEAST TERN
WILLET
SHOVELER
PELICAN
MARSH HAWK
SCAUP
MEADOWLARK
AVOCET
SANDPIPER
RUDDY DUCK
SALT MARSH SONG SPARROW
CANVASBACK
LEAST TERN
LONG BILLED MARSH WREN
KILLDEER
SOME TYPICAL ANIMAL SPECIES
PHALAROPE
PHALAROPE
MEADOW MOUSE
KILLDEER
CLAPPER RAIL
WILLET
BLACK TAILED JACKRABBIT
MEADOW MOUSE
SALT MARSH HARVEST MOUSE
VAGRANT SHREW
MUSKRAT
MEADOW MOUSE
GREBE
AVOCET
SANDPIPER
GREBE

Section A is a section through portions of the Baylands which have been modified and developed by man.

Section B is a section through portions of relatively undisturbed, high-value biological habitat. Neither section represents an actual South Bay location.

Derived and Modified from USFWS (1975)

Figure II-13
TWO SCHEMATIC CROSS-SECTIONS OF THE BAYLANDS OF SOUTH SAN FRANCISCO BAY.

Table II-10

EXISTING NOISE LEVELS NEAR AND ALONG THE PROPOSED PIPELINE ALIGNMENT

Location(1)	Feet from Alignment	Existing Noise Levels (dBA)(3)		Major Noise Sources
		Leq(2)	L90	
1	1,500	61	47	Aircraft, birds
2	500	59	50	Aircraft, road traffic, waterfowl
3	1,800	57	53	Aircraft, freeway traffic
4	1,500	58	51	Aircraft, freeway and street traffic, bulldozer
5	500	65	48	Truck traffic, birds, aircraft
6	3,500	65	50	Aircraft, birds, domestic animals
7	4,000	58	54	Aircraft, birds, sewage treatment plant

Notes:

(1) Geographical description of noise monitoring locations (see Figure II-12):

1. In front of the residence at Cooley Landing at the north end of Bay Road in Menlo Park.
2. East side of duck pond near yacht club at the north end of Embarcadero Road in Palo Alto.
3. Near home in front of the Colorado Power Station on Colorado Avenue about 300 feet southwest of Bayshore Freeway in Palo Alto.
4. About 1,000 feet from Bayshore Freeway at the intersection of Casey and Marine Streets in Mountain View.
5. Near the residence at 2306 Stierlin Road and in front of the public dump site in Mountain View.
6. In the vacant lot near the residence at 970 Elizabeth Street in Alviso, San Jose.
7. In the backyard of the residence at 934 Zanker Road in San Jose.

(2) Leq is the equivalent or "average", sound level in A-weighted decibels (dBA), and L90 is the noise level exceeded 90 percent of the time.

(3) The A-weighted noise level is a unit of sound measurement, electronically determined to simulate human hearing sensitivity, which accounts for both the frequency spectrum and the overall sound pressure level.

In spite of the importance of the South Bay environment to the support of local and regional fish and wildlife, the biology of the area has not been particularly well studied. The following discussion is based largely on the work of Gill (1973), Anderson (1970), and Delisle (1966), supplemented by site-specific field studies conducted in potentially sensitive localities along the proposed pipeline alignment. The results of these field surveys are presented in Appendices H and I, while a summary of the literature is presented in table form in Appendix G.

Open Water. The open water environment is that portion of the Bay covered by water at low tide. Within the southern portion of San Francisco Bay below the San Mateo Bridge, the open water environment, which comprises approximately 14 percent of the South Bay surface area, is restricted to the central ship channel, adjacent shoals, and deeper sloughs, as shown in Figure II-14.

Poor water quality has decreased the diversity of species living within this environment, especially in the southern portion of San Francisco Bay. Much of this poor water quality, and thus reduced biological productivity, has been attributed to wastewater

LEGEND

■ Grasslands

■ Salt Ponds

■ Salt Marshes And Slough "Eyebrows"

■ Managed Marsh, Primarily Fresh Water

□ Oxidation Ponds

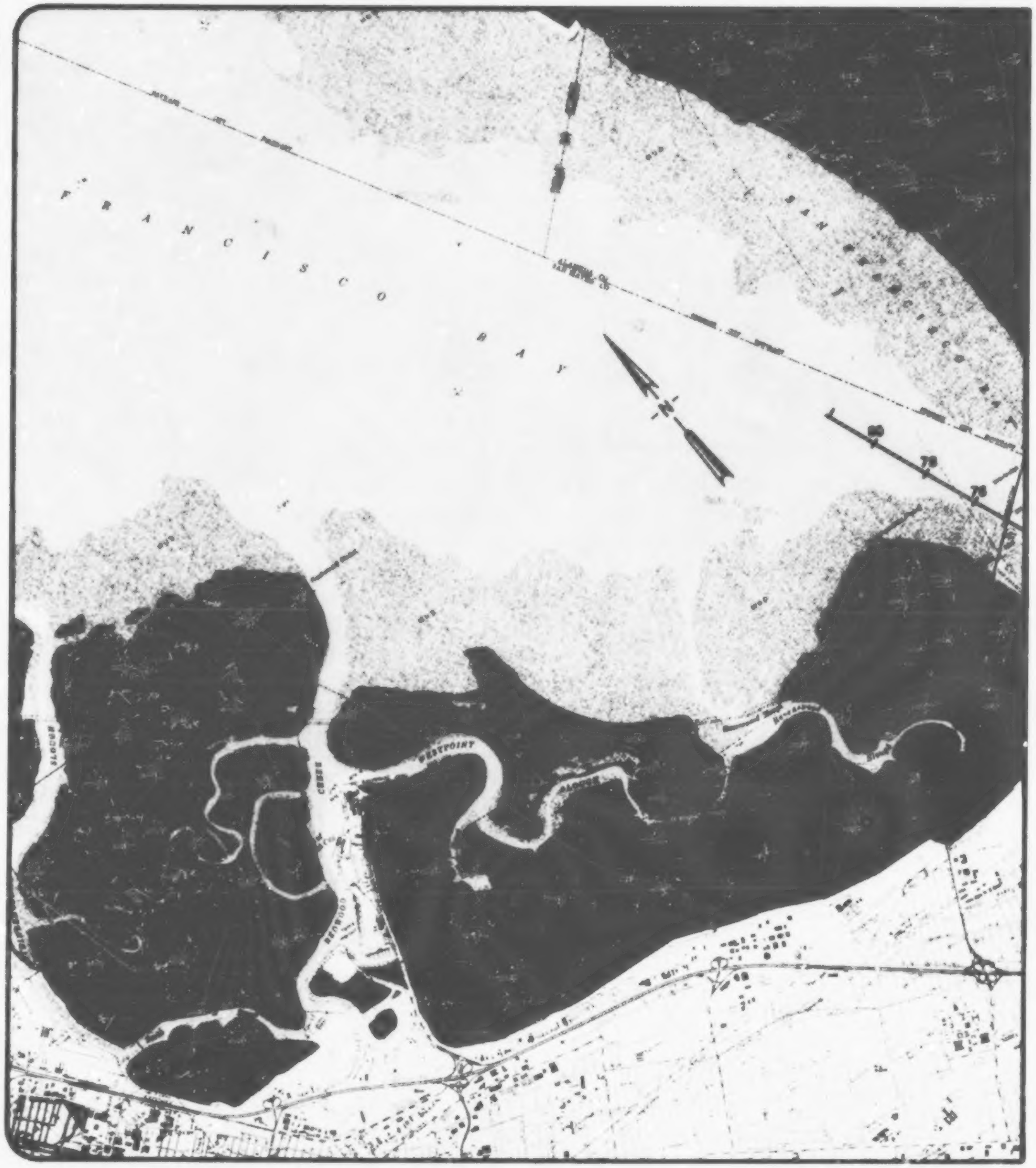

FRANCISCO BAY
SAN FRANCISCO BAY
N
SLOUGH
CREEK
WESTPOINT
SLOUGH
REDWOOD

Figure II-14
HABITAT MAP

discharges (Section II.1.1). The benthic species typical of the South Bay seem to show a strong seasonal variation within this open water environment (Appendix H).

An important ecological value of the open water habitat is the transport of organic detritus, inorganic chemicals, and plankton across the expansive mud flats at each ebb tide. This transport of the breakdown and waste products of plants and animals living in the marshes is the basic ecological link within the Bay ecosystem (Harvey, 1966). These materials become a prime food source for filter feeding clams, marine worms, and other detritus feeders that are in turn available to wading birds, fishes, and other carnivores.

Although the fish catch decreases south of the Dumbarton Bridge, striped bass, sturgeon, flounder, and skate are known to feed in the open waters and larger sloughs and over the tidal mud flats during flood tide. Sport fishing is not a major endeavor in the South Bay; one percent or less of the striped bass tagged catches were caught south of San Mateo Bridge since 1969 (California Fish and Game, personal communication, March 1978). Steelhead runs in San Francisquito Creek are protected. However, several party boats do operate in the area, catching striped bass, white sturgeon, flounder, and skates. In addition, commercial shrimp boats fish in the area, primarily for bait (California Fish and Game, personal communication, April 1978, and Lane, personal communication, June 1978).

The Basin Plan Alternative alignment passes through the open water habitat between the outer edge of the mud flats off Cooley Landing and the discharge point north of the Dumbarton Bridge, as shown in Figure II-14. A benthic species sampling program was conducted to determine the relative biological productivity of the Bay bottom. Benthic sampling points are illustrated in Figure II-15. The data obtained for October 1975 are summarized in Table II-10; the complete survey reports are presented in Appendix H. It should be noted that variability in population size of various species, and in population distributions, place severe limits on sampling efficiency. However, physical conditions such as sediment size do appear to affect species composition at any one station, and therefore species composition throughout the South Bay. It is not known to what extent diversity is limited by past and present wastewater discharges. However, the species composition, distribution, size, and diversity may be related in part to sediment degradation due to waste discharges (highly organic muds near the southern extremities) as well as by sediment size and salinity. The contribution of the wastewater element on diversity, however, may be masked by the effects of other uncontrollable parameters such as sediment size (Hydroscience, 1972).

Tidal Mud Flats. Mud flats are an extensive feature of the South Bay, covering about 13,500 acres between the low and high tide marks, or about 29 percent of the total area (Gill, 1973). The flats grade into salt marsh habitats in many areas and continue up into the mouths of streams and sloughs.

More than 100 species of invertebrates have been collected and identified from South Bay mud flats. Some of the more common invertebrates reported by Harvey (1966) are roundworms, ribbon worms, segmented worms, crustaceans (barnacles, shore crabs, and commercial crabs), and mollusks (Japanese littleneck clams, bent-nosed clams, oysters, ribbed mussels, bay mussels, mud snails, moon snails, and California horn snails). Shellfish beds of particular concern are located on mud flats to the north of Dumbarton Bridge along the west border of the Bay from San Mateo Bridge north (RWQCB, personal communication, 1975). Species identified during the biological surveys for October 1975 are summarized in Table II-11, and detailed in Appendix H.

Not all parts of the mud flats are equally productive. Protected and unpolluted estuarine flats and flats within sloughs with finer textured sediments provide an excellent habitat for many invertebrates. The continuous deposition of plant detritus results in the maintenance of quality feeding grounds for resident and migratory shorebirds.

CONTENTS

Section Page

I DESCRIPTION OF BASIN PLAN AND ALTERNATIVES

I.1 DESCRIPTION OF ALTERNATIVES 1 1/D13
  I.1.1 Introduction 1 1/D13
  I.1.2 Background and Objectives 4 1/E5
  I.1.3 Criteria for Evaluation of Alternatives 6 1/E9
  I.1.4 Evaluation of Alternatives 6 1/E9
    Alternative 2 — No Further Action 9 1/F1
    Alternative 3 — Individual Outfalls to Nearest Deepwater 10 1/F3
    Alternative 4 — Local Discharge with Upgraded Treatment 11 1/F5
    Alternative 5 — Reclamation and Reuse of Treated Wastewater 13 1/F9
  I.1.5 Alternative Alignments to Basin Plan Alternative 15 1/F13
I.2 THE BASIN PLAN ALTERNATIVE 19 1/G7
  I.2.1 Location 19 1/G7
  I.2.2 Facilities for the Basin Plan Alternative 21 1/G11
    San Jose/Santa Clara Pumping Station 22 1/G13
    Pipeline Segment — San Jose Santa Clara to Sunnyvale 22 1/G13
    Sunnyvale Pumping Station 22 1/G13
    Pipeline Segment — Sunnyvale to Palo Alto 24 2/B1
    Palo Alto Pumping Station 24 2/B1
    Pipeline Segment — Palo Alto to Discharge Point 24 2/B1
    Diffuser 24 2/B1
  I.2.3 Construction of the Basin Plan Alternative 25 2/B3
    Construction Procedures on Land 25 2/B3
    Construction Procedures in Water 26 2/B5
  I.2.4 Operation of the Basin Plan Alternative 28 2/B9
I.3 APPROVALS REQUIRED 29 2/B11

II ENVIRONMENTAL DESCRIPTION

II.1 PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT) 31 2/C3
II.1.1 Physical Environment 31 2/C3
  Topography 31 2/C3
  Geology and Seismology 33 2/C7
  Groundwater 33 2/C7
  Soils 36 2/C13
  Sediments 37 2/D1
  Meteorology 39 2/D5
  Air Quality 40 2/D7
    — The Air Pollution Problem in the Bay Area 40 2/D7
    — Emissions and Air Quality 40 2/D7
    — Air Quality in the Bay Area 45 2/E3
    — Air Impacts of Wastewater Disposal 45 2/E3
  Hydrology 45 2/E3
    — Tides and Currents 46 2/E5
    — Circulation and Dispersion 47 2/E7
  Water Quality 49 2/E11
    — Temperature 51 2/F1
    — Transparency 51 2/F1
    — pH 51 2/F1
    — Suspended Solids 51 2/F1
    — Salinity 52 2/F3
    — Dissolved Oxygen and Oxygen Demand 53 2/F5
    — Nutrients 53 2/F5
    — Chlorophyll 54 2/F7
    — Coliform Bacteria 54 2/F7
    — Oil and Grease 55 2/F9
    — Toxicity 55 2/F9
    — Heavy Metals 57 2/F13
  Noise 57 2/F13
II.1.2 Biological Environment 58 2/G1
  South Bay Habitats 58 2/G1
    — Open Water 61 2/G7
    — Tidal Mud Flats 64 2/G13
    — Salt Marsh 68 3/B5
    — Salt Ponds 71 3/B11
    Dikes and Levees 74 3/C3
    — Grasslands 75 3/C5
    — Streams and Sloughs 75 3/C5
    — Freshwater Marshes and Ponds 77 3/C9
  Species of Special Concern 78 3/C11

II.1.3 Social, Economic, and Cultural Environment 83 3/D7
Population and Demography 83 3/D7
Recreational and Scientific Uses of the Area 87 3/E1
Archaeological, Paleontological, Historical and Cultural Resources 88 3/E3
— Archaeological Resources 88 3/E3
— Paleontological Resources 89 3/E5
— Historical and Cultural Resources 89 3/E5
Visual and Aesthetic Setting 93 3/E13
Economic Setting 98 3/F9

II.2 LAND USE

II.2.1 Present Land-Use Patterns 101 3/G1
Existing Land Use 101 3/G1
— Santa Clara County 101 3/G1
— San Mateo County 104 3/G7
Existing Public and Private Developments 104 3/G7
Mineral Resources of the Baylands 112 4/B7
II.2.2 Projected Land-Use Patterns 112 4/B7
Planned Public and Private Developments 112 4/B7
Land-Use Plans and Planning Agencies 114 4/B11
Interested Agencies 118 4/C5
— Local 118 4/C5
— Regional 118 4/C5
— State 118 4/C5
— Federal 119 4/C7

II.3 WATER USE

II.3.1 Existing and Proposed Wastewater Treatment Facilities 120 4/C9
San Jose/Santa Clara Regional Water Pollution Control Plant 120 4/C9
Sunnyvale Water Pollution Control Plant 120 4/C9
Palo Alto Treatment Plant 121 4/C11
Menlo Park Sanitary District Wastewater Treatment Plant 121 4/C11
Redwood City Sanitary District — Redwood City Sewage Treatment Facility 121 4/C11
Redwood City Sanitary District — Redwood Shores Plant 122 4/C13
Belmont/San Carlos Joint Sewage Treatment Facility 122 4/C13
Proposed Redwood Shores Subregional Plant 122 4/C13
Union Sanitary District — Alvarado, Plant No. 3 122 4/C13
Union Sanitary District — Newark, Plant No. 1 122 4/C13
Union Sanitary District — Irvington, Plant No. 2 122 4/C13
II.3.2 Current and Projected Sources of Water 122 4/C13
II.3.3 Current Water Use and Projected Demand 123 4/D1
II.3.4 Current and Projected Water Quality 123 4/D1

III ENVIRONMENTAL IMPACTS

III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129 4/E1
III.1.1 Construction Impacts 129 4/E1
Physical Environment 129 4/E1
— Topography 129 4/E1
— Air Quality 130 4/E3
— Water Quality 131 4/E5
— Sediment Quality 132 4/E7
— Noise 132 4/E7
Biological Environment 133 4/E9
— Segment I — San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134 4/E11
— Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant 136 4/F1
— Segment III — Palo Alto Treatment Plant to Discharge Point 138 4/F5
Social, Economic, and Cultural Environment 140 4/F9
— Recreational Uses of the Area 140 4/F9

— Archaeological, Paleontological, and Historical Resources 141 4/F11
— Visual and Aesthetic Setting 141 4/F11
— Economic Setting 141 4/F11
— Present Land-Use Patterns 143 4/G1
— Projected Land-Use Patterns 144 4/G3
III.1.2 Operation Impacts 144 4/G3
Physical Environment 144 4/G3
— Hydrology 144 4/G3
— Water Quality 144 4/G3
— Sediment Quality 148 4/G11
— Noise 150 5/A13
Biological Environment 152 5/B3
Social, Economic, and Cultural Environment 154 5/B7
— Recreational Uses of the Area 154 5/B7
— Visual and Aesthetic Setting 155 5/B9
— Present and Future Land-Use 155 5/B9
— Energy Consumption 155 5/B9
III.1.3 Economic Impact of the Basin Plan Alternative 155 5/B9
Introduction 155 5/B9
Study Assumptions and Methodology 155 5/B9
— Capital Costs 156 5/B11
— Operation and Maintenance Costs 158 5/C1
Computation of Allocation Factors 158 5/C1
User Charges to Discharger Groups 159 5/C3
— Residential Dischargers 159 5/C3
— Commercial Dischargers 159 5/C3
— Industrial Dischargers 159 5/C3
— Direct Impact on Industrial Dischargers 162 5/C9
Analysis of the Canned Fruit and Vegetable Industry 163 5/C11
— Industry Characteristics 163 5/C11
— Methodology 164 5/C13
— Conclusions of Analysis 165 5/D1
Conclusions 165 5/D1
III.1.4 Accident or Natural Catastrophe 166 5/D3
Flooding 166 5/D3
Earthquake 166 5/D3
Plant Upset 166 5/D3
Pumping Station Malfunction 166 5/D3
III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168 5/D7
III.2.1 Adverse Construction Effects 168 5/D7
Physical Environment 168 5/D7
Biological Environment 168 5/D7
Social, Economic, and Cultural Environment 168 5/D7
III.2.2 Adverse Operational Effects 169 5/D9
Physical Environment 169 5/D9
Biological Environment 169 5/D9
Social, Economic, and Cultural Environment 169 5/D9
III.3 MITIGATION MEASURES 170 5/D11
III.3.1 Mitigation of Construction Impacts 170 5/D11
Proposed Measures 170 5/D11
Potential Measures 172 5/E2
III.3.2 Mitigation of Operation Impacts 173 5/E3
Proposed Measures 173 5/E3
Potential Measures 173 5/E3
III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174 5/E5
III.4.1 Short-Term Uses of Man's Environment 174 5/E5
III.4.2 Maintenance and Enhancement of Long-Term Productivity 174 5/E5
III.4.3 Need for the Project 175 5/E7
III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176 5/E9
III.5.1 Permanent Changes in Land Features and Land Use 177 5/E11
III.5.2 Biological Systems 177 5/E11
III.5.3 Assimilative Capacity of the Bay 177 5/E11
III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177 5/E11
III.6 GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178 5/E13

IV ALTERNATIVES TO THE BASIN PLAN

IV.1 INTRODUCTION 181 5/F7
IV.2 ALTERNATIVES 182 5/F9

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183 5/F11
Participation by Other Entities 184 5/F13
Alternative Alignments 184 5/F13
Result of Screening 185 5/G1
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188 5/G7
Result of Screening 190 5/G11
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190 5/G11
Result of Screening 191 5/G13
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193 6/B1
Result of Screening 195 6/B5
IV.2.5 Alternative 5 — Reclamation and Reuse 195 6/B5
Reclamation in Santa Clara County 197 6/B9
Smaller Reuse Markets in the Service Area 199 6/B13
Markets Outside the Service Area 201 6/C3
Result of Screening 202 6/C5
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202 6/C5
Result of Screening 203 6/C7
IV.2.7 Alternative 7 - Discharge to the Ocean 203 6/C7
Result of Screening 204 6/C9
IV.2.8 Alternative 8 — Land Disposal 204 6/C9
Result of Screening 205 6/C11
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206 6/C13
Result of Screening 206 6/C13
V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION
V.1 INTRODUCTION 207 6/D3
V.2 STUDY AREA 209 6/D7
V.2.1 Location of Study Area 210 6/D9
V.2.2 Water Demand and Supply 210 6/D9
V.2.3 Quality of Groundwater Supplies 213 6/E1
V.2.4 Quality of Soils 213 6/E1
V.2.5 Agricultural Land Use 215 6/E5
V.3 CONCEPTUAL DESIGN 217 6/E9
V.3.1 Potential Markets 218 6/E11
V.3.2 Reclaimed Water Quality 219 6/E13
Source Control 221 6/F3
Level of Reclaimed Water Treatment 222 6/F5
V.3.3 Treatment Conceptual Designs 224 6/F9
Reclaimed Water Flow Diversion 226 6/F13
Coagulation and Sedimentation with Alkalinity Control 226 6/F13
Alkalinity Control 230 6/G7
Partial Desalination Treatment 232 6/G11
V.3.4 Conveyance and Distribution Conceptual Designs 233 6/G13
Pumping 234 7/A13
Conveyance Pipeline 235 7/B1
Santa Clara Valley Distribution System 236 7/B3
Bolsa Distribution System 236 7/B3
User Connections 236 7/B3
V.3.5 Cost Estimates 242 7/C1
Basis of Estimate 242 7/C1
Engineering Construction Management Contingency 244 7/C5
Escalation 244 7/C5
Schedule 244 7/C5
Operation and Maintenance 244 7/C5
Major Exclusions 244 7/C5
Assumptions 244 7/C5
V.3.6 Blending Alternatives 244 7/C5
Blended Water Quality 245 7/C7
Blended Water Markets 245 7/C7
Blended Water Distribution 246 7/C9
Blending System Alternatives 247 7/C11
V.3.7 Alternating Supply Alternatives 247 7/C11
V.3.8 Summary 248 7/C13
V.4 AGRICULTURAL IMPACTS 249 7/D1
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250 7/D3
Salinity Effects 251 7/D5
Effects of High Sodium Concentrations 253 7/D9

Specific Ion Toxicity 255 7/D13
Summary of Effects on Agriculture of Cases A and B 255 7/D13
V.4.2 Impact of Cases C, D, B$_1$, B$_2$, and B$_3$ in the Santa Clara County Portion of the Study Area 256 7/E1
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257 7/E3
V.5 ECONOMIC IMPACT ANALYSIS 259 7/E7
V.5.1 Conceptual Level Costs 259 7/E7
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260 7/E9
V.5.3 Economic Impact on Agriculture 260 7/E9
V.6 OTHER IMPACTS 263 7/F1
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264 7/F3
V.6.2 Long-Term Buildup of Salts in Soil 265 7/F5
V.6.3 Public Health Concerns 265 7/F5
V.6.4 Effects on Land Use and Water Use 266 7/F7
V.6.5 Energy Consumption 266 7/F7
V.6.6 Other Effects 267 7/F9

VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270 7/G3
VI.1.1 Disposal of Bittern 271 7/G5
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272 7/G7
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273 7/G9
VI.1.4 Other Disposal Alternatives 276 8/A13
Continued Storage 276 8/A13
On-Land Dilution 276 8/A13
VI.2 PRESENT ENVIRONMENT 277 8/B1
VI.2.1 Physical Environment 277 8/B1
Topography 277 8/B1
Soils 278 8/B3
Sediments 278 8/B3
Hydrology 278 8/B3
Water Quality 278 8/B3
– Temperature and Salinity 278 8/B3
– Chemical Characteristics 280 8/B7
VI.2.2 Biological Environment 280 8/B7
Open Water and Tidal Mud Flats 280 8/B7
Salt Marsh 280 8/B7
Salt Ponds 280 8/B7
Dikes and Levees 282 8/B11
Streams and Sloughs 282 8/B11
Species of Special Concern 283 8/B13
VI.2.3 Social and Cultural Environment 283 8/B13
Recreational Uses of the Area 283 8/B13
Archaeological, Paleontological, Historical, and Cultural Resources 284 8/C1
Visual and Aesthetic Setting 284 8/C1
Existing and Proposed Land Use 284 8/C1
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285 8/C3
VI.3.1 Discharging to Basin Plan Alternative 285 8/C3
Construction Impacts – Physical Environment 285 8/C3
– Topography 285 8/C3
– Air Quality 285 8/C3
– Water Quality 286 8/C5
– Sediment Quality 286 8/C5
– Noise 286 8/C5
Construction Impacts – Biological Environment 286 8/C5
– Salt Pond Dikes 286 8/C5
– Open Water 286 8/C5
Construction Impacts – Social, Economic, and Cultural Environment 287 8/C7
– Recreational Uses of the Area 287 8/C7
– Archaeological, Paleontological, and Historical Resources 287 8/C7
– Economic Setting 287 8/C7
– Present and Projected Land-Use Patterns 287 8/C7
Operational Impacts – Physical Environment 287 8/C7
– Water Quality 287 8/C7
– Sediment Quality 290 8/C13
– Noise 290 8/C13
Operational Impacts – Biological Environment 291 8/D1

Operational Impacts — Social, Economic, and Cultural Environment 292 8/D3
— Economic Setting 292 8/D3
VI.3.2 Discharging Through Separate Diffusers 292 8/D3
Construction Impacts — Physical Environment 292 8/D3
— Topography 292 8/D3
— Air Quality 292 8/D3
— Water Quality 292 8/D3
— Sediment Quality 292 8/D3
— Noise 292 8/D3
Construction Impacts — Biological Environment 293 8/D5
— Salt Pond Dikes 293 8/D5
— Open Water 293 8/D5
Construction Impacts — Social, Economic, and Cultural Environment 293 8/D5
— Recreational Uses of the Area 293 8/D5
— Visual and Aesthetic Setting 293 8/D5
— Economic Setting 293 8/D5
— Present and Projected Land-Use Pattern 294 8/D7
Operational Impacts — Physical Environment 294 8/D7
— Water Quality 294 8/D7
— Sediment Quality 295 8/D9
— Noise 295 8/D9
Operational Impacts - Biological Environment 296 8/D11
Operational Impacts — Social, Economic, and Cultural Environment 297 8/D13
— Economic Setting 297 8/D13
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298 8/E1
VI.4.1 Unavoidable Adverse Environmental Impacts 298 8/E1
VI.4.2 Mitigation Measures 298 8/E1
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299 8/E3
Short-Term Uses of Man's Environment 299 8/E3
Maintenance or Enhancement of Long-Term Productivity 299 8/E3
Need for the Project 299 8/E3
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302 8/E9
Permanent Changes in Land Features and Land Use 302 8/E9
Biological Systems 302 8/E9
Assimilative Capacity of the Bay 302 8/E9
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302 8/E9
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302 8/E9
VII SOURCES OF INFORMATION
VII.1 REFERENCES 305 8/F1
VII.1.1 Literature Cited in Text 305 8/F1
VII.1.2 Literature Cited in Figures 312 8/G1
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313 8/G3
VII.3 CONTACTS 316 8/G9
VII.4 DISTRIBUTION LIST 335 9/D3
VII.4.1 Federal Agencies 335 9/D3
VII.4.2 Libraries 338 9/D9
VII.4.3 Individuals and Private Groups 339 9/D11
VII.4.4 State Agencies 347 9/E13
VII.4.5 Regional Agencies and Local Government 348 9/F1
VII.4.6 Legislators 352 9/F9
VII.4.7 News Media 353 9/F11

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

Table II-11

COMMON SPECIES AT BENTHIC STATIONS ON OR IN THE VICINITY OF RECOMMENDED PIPELINE ALIGNMENT(1)

Organisms	Stations (October 1975) (2)									
	8	9	11	13	16	17	27	28	29	30
Polychaeta										
Streblospio benedicti	7	8	30(3)	24(3)	24(3)	8(3),	24(3)	100(3)	150(3)	16
Asychis elongata	14	24	-	24	22	-	-	4	37	16
Marphysa sanguinea	7	-	-	6	6	-	33	17	-	11
Glycinde polygnatha	-	12	10	16	-	-	10	-	8	9
Neanthes succinea	8	-	-	-	-	-	-	-	-	5
Nephtys caecoides	-	5	5	-	-	-	-	-	-	-
Exogone lourei	-	8	6	-	-	8(3)	50(3)	-	-	14(3)
Heteromastus filiformis	1	-	13	16	15	18	20	51	22	110
Harmothoe imbricata	-	-	-	-	-	-	4	-	-	-
Amaeana occidentalis	-	-	-	-	-	-	-	19	-	-
Bivalvia										
Gemma gemma	26	47	12	-	-	-	-	-	-	-
Lyonsia californica	8	5	28	-	-	-	-	-	-	-
Modiolus senhousia	52	185	9	224	69	47	-	27	267	29
Macoma inquinata	19	-	11	-	-	-	-	-	-	-
Macoma balthica	6	-	-	-	-	-	-	-	-	-
Tapes japonica	-	-	-	-	-	-	-	-	7	-
Gastropoda										
Crepidula fornicata	-	-	-	-	-	10	-	-	-	-
Arthropoda										
Ampelisca milleri	-	-	25	14	42(3)	-	-	18	175	148
Microdeutopus schmitti	-	-	-	-	-	-	-	-	-	14
Sarsiella sp.	-	-	-	-	-	-	-	-	-	21(3)
Ectoprocta - None										
Oligochaeta										
Peloscolex apectinatus	264(3)	200(3)	8(3)	56(3)	8(3)	80(3)	8(3)	100(3)	150(3)	104(3)
P. gabriellae	-	-	24(3)	-	10(3)	-	56(3)	-	-	64(3)
P. nerthoides	-	-	1(3)	-	-	-	-	-	-	-
Cnidaria - None										
Urochordata										
Ciona intestinalis	-	82	-	-	-	-	-	-	-	7
Chordata - None										

Notes:

(1) Only those species represented by five or more specimens at a station are presented in this table. For greater detail, see Appendix H. All stations are predominantly mud (phi ≥ 0.1) except Station 27, which contained large numbers of shell fragments. Stations are shown in Figures II-15 and H-1.

(2) Selected to show spatial variation. These stations may be compared with other seasons by referring to Appendix H. See Figure II-15 for location.

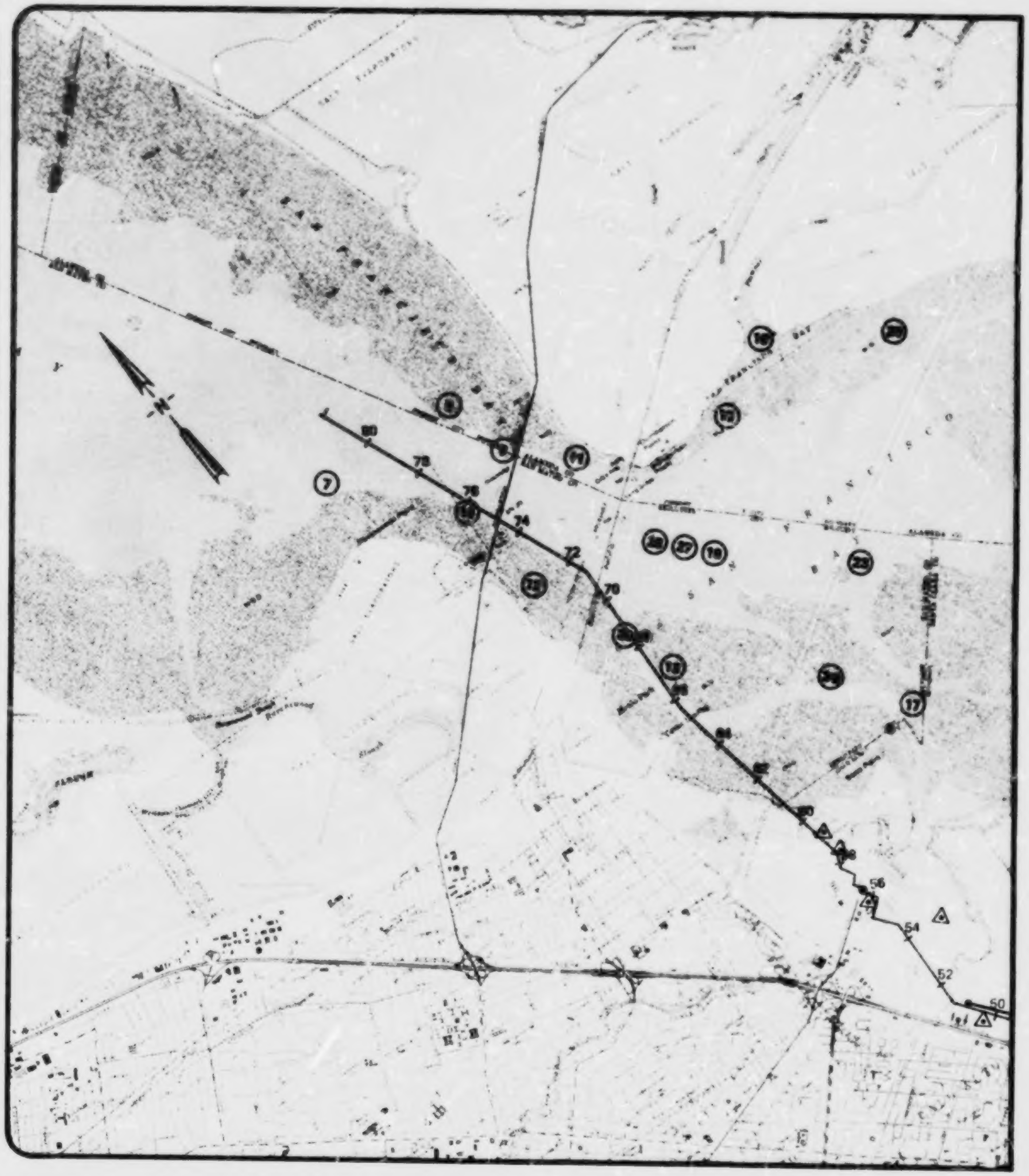
(3) Estimated numbers.

LEGEND

⑫ Benthic Faunal Station

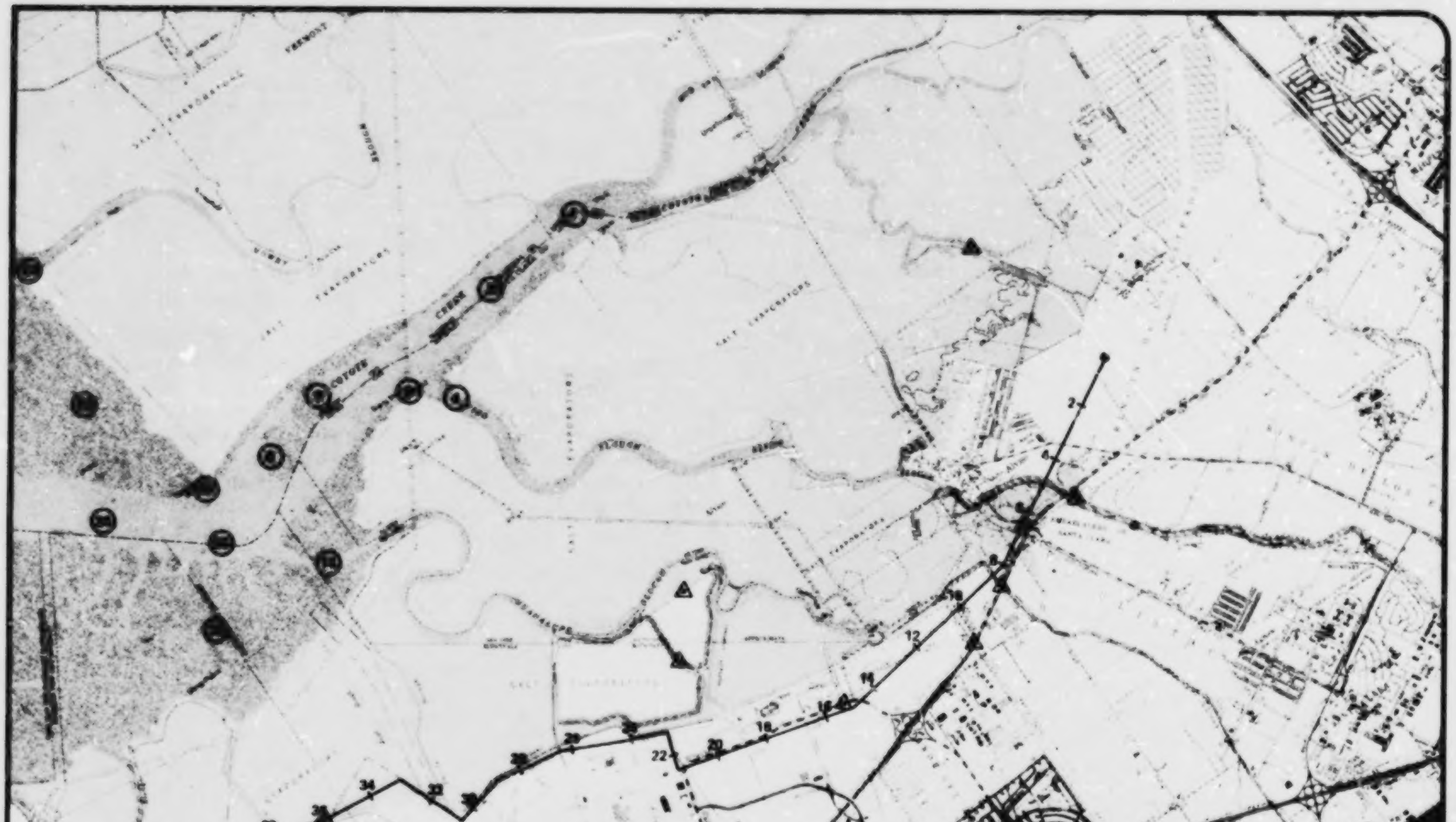
●—● Small Mammal Trapping

◬ Qualitative Terrestrial Survey Station (approximate center point of area surveyed)



N
⑦
⑰
80
78
76
74
72
70
56
54
52
50

Figure II-15
BIOLOGICAL SURVEYS


COYOTE CREEK
SALT EVAPORATORS
SLOUGH
SCALE IN MILES
2
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46

The higher productivity of inshore and slough mud flats is indicated by the large number of shorebirds commonly observed feeding on the exposed flats. Some of the species of shorebirds known to feed on the flats within the southern portions of San Francisco Bay are the killdeer, the black-bellied plover, the willet, the western sandpiper, dowitchers, the marbled godwit, and the avocet (Gill, 1973; Bollman, et al., 1970). When the tide is in, ducks, grebes, and other diving and dabbling birds may feed over the same flats.

The Basin Plan Alternative alignment crosses mud flats between Stations 60 and 64 (Figure II-14), off Palo Alto Municipal Airport. Representative species of the benthic community in this corridor include *Asychis Elongata* (annelid worm), *Modiolus senhousia*, *Gemma gemma* (bivalves), and *Nassarius obsoletus* (gastropod).

Other highly productive mud flats in the general area of the alignment include portions of Artesian and Alviso Sloughs and the Palo Alto Yacht Harbor system. The highest densities of shorebirds noted in field studies for this report occurred in these three areas.

Salt Marsh. The transition zone between the mud flats and dry uplands is normally occupied by a salt marsh community, dominated by an assemblage of salt-tolerant seed plants capable of rooting in the softer mud below the high tide range. Much of the work on salt marshes, their productivity, and their value to marine life, has been based on studies of marshes in Europe and the Atlantic Coast of the U.S. However, the unique configuration of San Francisco Bay with two distinct seasons (wet and dry) complicate classification of the Bay Areas marshes; indeed, they may be unique to the Bay (Smith; see June 27, 1978 report in Appendix H). Many of the "typical" species may not even be native to the Bay (Wright, SWRCB, personal communication, July 1978 and Appendix H).

Prior to the mid-1800's, salt marshes covered most of the entire South Bay border. With the installation of salt evaporation ponds and the filling of much of the Bay margin, the area remaining as salt marsh in the South Bay has been reduced to slightly more than 4,200 acres, 9 percent of the present surface area (see Figure II-14). Most estuarine life within the Bay depends for its sustenance directly or indirectly on the salt marsh and mud flat plants. Animal wastes, together with the decomposition products of plant decay, contribute nutrients to the marshes, which, in turn, are distributed to the mud flats and the adjacent shallows of the Bay. Compared to other natural plant communities, salt marshes are the most productive habitats in North America (Odum, 1971).

Much of the salt marsh remaining in the South Bay is found in bands along the fringe of salt ponds and sloughs. These bands, commonly called "eyebrows," provide a discontinuous ring of varying thickness around the edge of the Bay. One of the larger, more accessible eyebrows is located on Alviso Slough immediately north of the easterly unit of the Sunnyvale oxidation ponds.

South Bay salt marshes can be conveniently subdivided into three vegetative associations. In the buffer area between the tidal mud flats and the higher tidelands (between 8.4 and 5.4 feet above MLLW), there is a band of grey-green emergent vegetation, commonly referred to as "cord grass" *(Spartina foliosa* or *S. Leiantha).* Cord grass is a sod and marsh building salt-tolerant plant that can withstand inundation but not dehydration. It provides habitat for epiphytic algae, such as diatoms, and the mud in which cord grass grows often supports Algal "mats" or "films."

Cord grass and its associated plant species may contribute significantly to the formation of rich detritus by the decay of leaves and stems. This detritus is an important food for many filter-feeding aquatic organisms (e.g., oysters, polychaete worms). In addition, the seeds of cord grass may contribute to the diet of migratory waterfowl, and some insects may feed on the leaves and stems. However, most of the food value of cord grass is passed as detritus to the mud flats and tidal shallows.

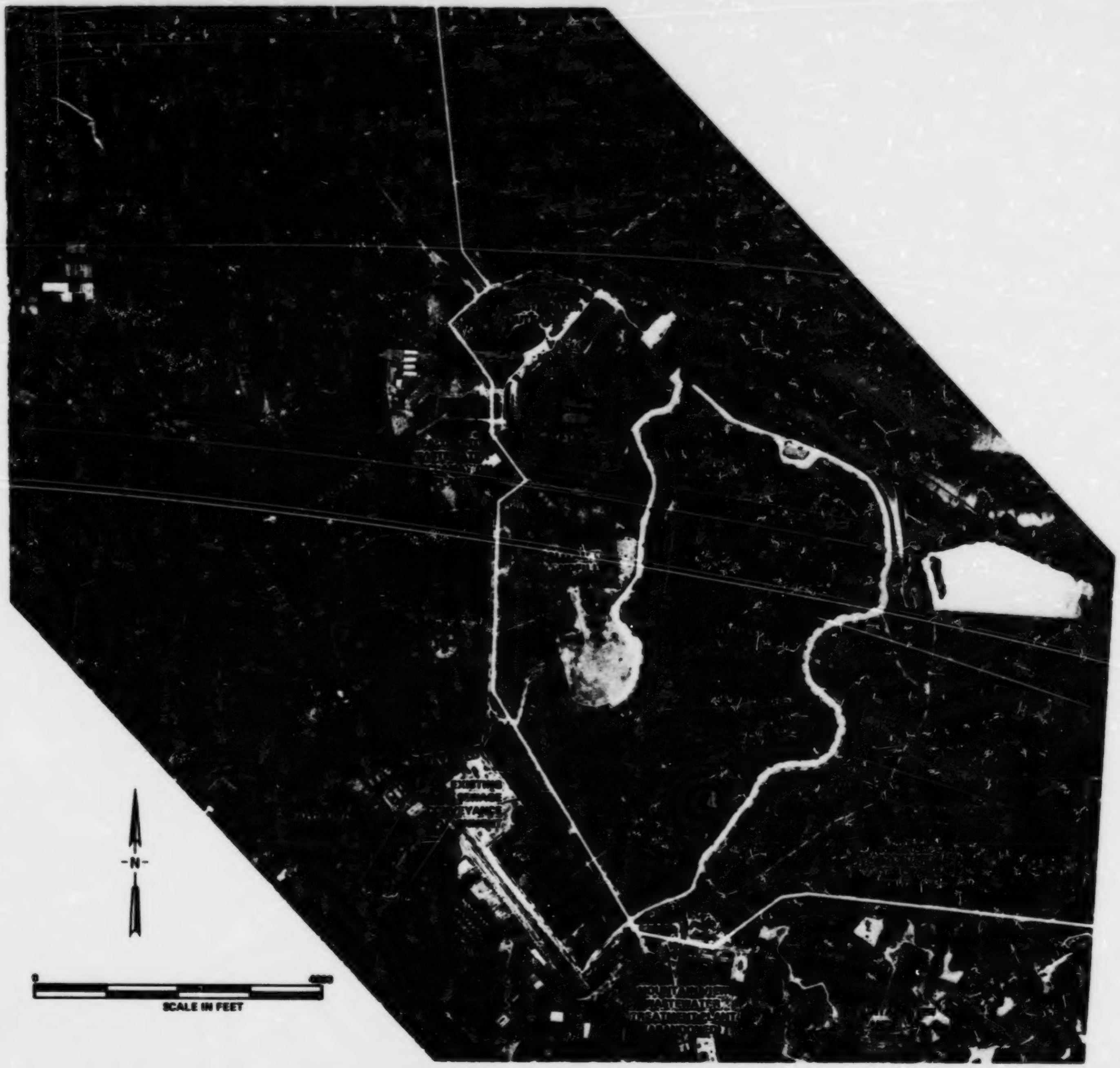
Behind the cord grass (10.4 to 6.41 feet above MLLW), pickleweed *(Salicornia sp.)* is the dominant plant. Picklewood forms dense, luxurious growths of vegetation, which in late summer gradually become dry and woody. Pickleweed is an important food of the American wigeon; other duck species are thought to ingest pickleweed only casually (Mall, 1969). Pickleweed is a perennial plant and does not contribute significantly to detritus in the annual growth-decay cycle of marshes. The major food plants in salt marshes, particularly for migrating waterfowl, consist of those associates of pickleweed that produce large quantities of edible seed and are readily accessible to wildlife. These plants include alkali bulrush (*Scirpus robustus*), brass buttons *(Cotula cornopifolia)*, and fat-hen *(Atriplex patula)*, all of which are either found in high water areas or produce large quantities of floating seed.

The third association consists of salt grass (*Distichlis spicata)* and other salt-tolerant plants which do not tolerate regular inundation. Found in the 10.3-7.15 feet above MLLW zone, this vegetation accounts for the shrubby appearance of many of the South Bay Baylands but is not clearly separable from the picklewood zone.

In addition to their high productivity, the salt marshes provide habitat for a variety of unique species and subspecies, including a number that are locally endemic (i.e., found no where else in the world). Three such endemic subspecies that feed and/or nest within the pickleweed habitat are the salt marsh harvest mouse, *Reithrodontomys raviventris raviventris*, the California clapper rail, *Rallus longirostris obsoletus*, and the Alemeda song sparrow, *Melospiza melodia pusillula*. The loss of salt marshes, through reclamation and development, has reduced the populations of these species to such low levels that they are quite rare and, in the case of the first two, in danger of extinction. These and other species of concern are discussed in greater depth following this discussion. Other species that commonly feed and/or nest in the salt marshes include the long-billed marsh wren, the white-tailed kite, the marsh hawk, the killdeer, the willet, the marbled godwit, and the avocet, and mammals such as shrews, racoons, weasels, skunks, and rabbits.

The Basin Plan Alternative alignment traverses four areas of salt marsh. The one with the highest ecological quality, nearly in its original condition, is situated near the Palo Alto Municipal Airport and Yacht Harbor. This area has been used as a study site by students from Bay Area colleges and universities - notably Universities of San Francisco, Stanford, and San Jose State. This area is shown in detail in Figure II-16. Studies of the Palo Alto salt marsh by Schaub (1971), Wandolleck (1975), and Gill (1973) and site-specific studies conducted for this report have established the presence of breeding populations of endangered or rare species, including the salt marsh harvest mouse, the California clapper rail, and the Alameda song sparrow (not all studies identified all species). Wandolleck estimated a total population of salt marsh harvest mice in the marsh at 250 in July 1972 and noted that the species preferred the area in the marsh with tall, lush growths of pickleweed mixed with salt grass, (*Distichlis spicata)* and alkali heath *(Frankenia grandifolia)*. This type of plant association is present along the lower third of the Palo Alto sewage channel. The immediate border of the sewage channel is vegetated with dense clumps of salt bush, forming a band approximately 20 feet wide on either side for the length of the channel.

In 1973, the California clapper rail density in the Palo Also salt marsh was estimated at 0.69 per acre by Gill (1973). Present densities are approximately 1.31 per hectare (3.24 per acre) in the South Bay area, indicating a population growth in the last decade (California Fish and Game, personal communication, April 1978). Clapper rails have been reported in Charleston, Guadelupe, and Alviso Sloughs. Gill reported that the cord grass portion of the marsh was of primary importance to the species, while the pickleweed sections were secondary, supporting only about two-thirds as many individuals. The upper two-thirds of the existing Palo Alto discharge channel is surrounded by cord grass.


N
0
SCALE IN FEET

PACIFIC RESOURCES INC. OAKLAND CA. PALO ALTO BAYLANDS RESERVE

The Alameda song sparrow population in the Palo Alto salt marsh was not studied by Gill, and site-specific densities are, therefore, not available. Based on his studies of salt marsh eyebrows and slough borders elsewhere in the South Bay, he estimated densities of 96 pairs per each 100 acres of marsh. The species nests in tall cord grass and high pickleweed clumps, both abundant in the Palo Alto salt marsh. The Alameda song sparrow was frequently sighted within 15 yards of the sewage channel during field studies for this report.

The second area of salt marsh coincident with the Basin Plan Alternative route is within the Palo Alto Baylands Reserve (see Figure II-16). This area of salt marsh was diked off from normal tidal fluctuation approximately twenty years ago for use as a flood control basin. The Baylands Reserve, established in 1965, was studied by the Palo Alto Department of Nature and Science in 1973, as part of an environmental assessment of the proposed rehabilitation of portions of the marsh (Martineau, undated; Kibler, et al., 1975). The biological resources of the entire Baylands area were also assessed and included in the EIR prepared for the City of Palo Alto as part of the Baylands Master Plan (Larry White, City of Palo Alto; John Walton, Baylands Reserve; personal communications, April 1978, and City of Palo Alto, 1976). In spite of the extensive modifications of normal salt marsh habitat, the area supports an extremely diverse flora and fauna.

The alignment in the Baylands Reserve crosses a patchy, poor quality pickleweed community that is dry most of the year. The absence of cord grass and the sparseness of pickleweed precludes the full utilization of the corridor by the animals endemic to the salt marsh. The results of live-trapping in October 1975 were negative for the salt marsh harvest mouse.

The third area of salt marsh in the Basin Plan Alternative corridor is located to the west of Saratoga Creek (Guadalupe Slough) between Station 9 and 9.5. This "field" of pickleweed is totally blocked from tidal flow by flood control dikes on Saratoga and Calabazas Creeks and is dry from late spring until the winter rains begin. Two nights of live-trapping in October 1975 produced one California vole and no salt marsh harvest mice.

The fourth salt marsh is located on either side of Alviso Road north of Highway 237. All but about a 40-yard-wide strip of marsh paralleling the Alviso Road on the west side and a triangle of marsh about 30 yards on a side have been covered with sanitary landfills. Salt marsh harvest mice may occur in the marsh on the west side of Alviso Road, but the trapping efforts in October 1975 produced no salt marsh harvest mice and revealed that any population of this species that may occur is competing with a large population of house mice (*Mus musculus)* which has presumably invaded the area from the adjacent landfill. A white-tailed kite was observed hunting over the marsh on October 2, 1975, indicating that the marsh is still of some ecological value, even in its present state.

Salt Ponds. Over 26,500 acres of the south Baylands, approximately 46 percent of the surface area, have been developed into salt evaporation ponds by the Leslie Salt Company. The ponds function as solar evaporation basins and are arranged and operated in a series. The chain of ponds below Dumbarton Bridge, known as the Alviso Unit, begins near Palo Alto and terminates at Leslie's Newark Plant on the opposite side of the Bay, as shown in Figure II-17. In May, brackish Bay water (salinity 20 parts per thousand) is drawn into pond A-1 from Charleston Slough. During the summer this water flows or is pumped from one pond to the next. As water evaporates, the salinity increases in each pond, and less soluble salts precipitate. Additional Bay water is added at intermediate points as needed, to maintain the total volume of water in the system. The solution in the ponds near the end of the series consists largely of sodium chloride at a concentration nearly four times that of seawater. This final concentrated solution is diverted into smaller evaporation beds where the remaining salts crystallize out and can be harvested.

LEGEND

– INDICATES LESLIE SALT CO.

↗ – INDICATES DIRECTION OF FLOW

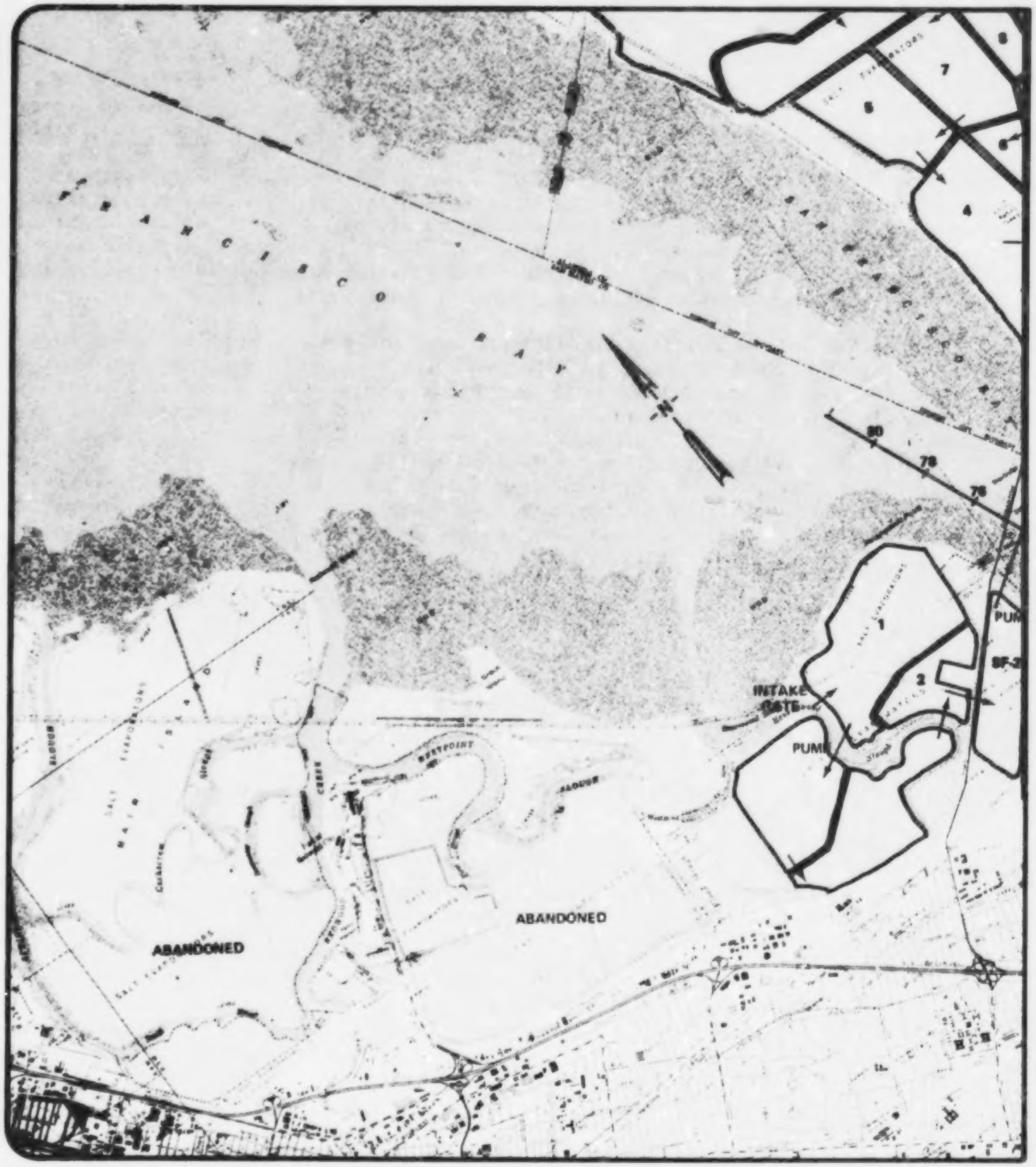
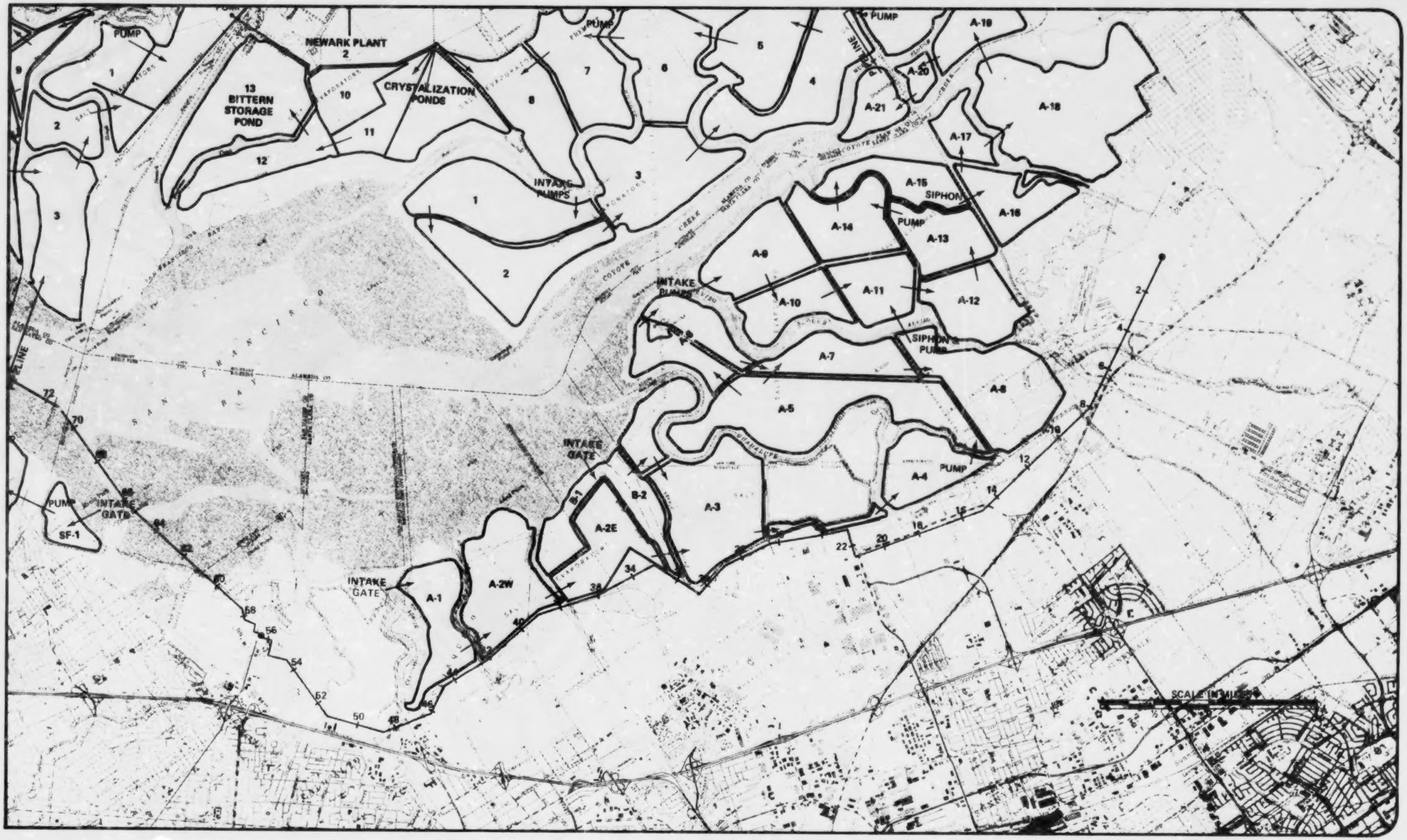

SAN FRANCISCO BAY
N
8
7
5
6
4
80
78
76
1
2
INTAKE GATE
PUMP
PUM
SF-2
SALT EVAPORATORS
SLOUGH
CREEK
ABANDONED
ABANDONED

Figure II-17
SALT PONDS IN THE SOUTH BAY


PUMP
NEWARK PLANT 2
13 BITTERN STORAGE POND
CRYSTALIZATION PONDS
1
2
3
10
11
12
9
PUMP
7
8
6
5
4
PUMP
A-19
A-20
A-21
A-18
A-17
INTAKE PUMPS
1
2
3
A-15
SIPHON
PUMP
A-16
A-14
A-13
A-9
A-10
A-11
A-12
INTAKE PUMPS
SIPHON & PUMP
A-7
A-8
A-5
INTAKE GATE
B-1
B-2
A-2E
A-3
PUMP
A-4
PUMP
INTAKE GATE
SF-1
INTAKE GATE
A-1
A-2W
SAN FRANCISCO BAY
COYOTE CREEK
SCALE IN MILES
½
72
70
68
66
64
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
22
20
18
16
14
12
10
8
6
4
2

The salinity within each pond averages 10 to 20 percent higher than the previous pond in the series, providing a wide variety of habitats for various estuarine and marine plants and animals. The aquatic species that occur in the A-1 through A-8 pond series have been characterized by Carpelan (1957). The ponds at the head of the series are dominated by green algae, plankton, invertebrates, and small fishes characteristic of the Bay. The community structure shifts markedly from pond A-3 through the remainder of the series. Only three species, an alga, a copepod, and a topsmelt, compose the aquatic food chain in pond A-3. The communities in the remaining ponds resemble those of inland salt lakes, with the brine shrimp becoming the dominant organism. A commercial brine shrimp fishery is in operation each summer in pond A-18. Many of the ponds become reddish in color due to growth of iron bacteria, producing the multicolored patchwork pattern so promient when viewed from the air.

Wildlife values of each pond are directly affected by the salinities and associated community types. Anderson (1970) and Gill (1973) have noted that bird use of South Bay salt ponds for feeding and resting is concentrated in the lower salinity ponds in each pond series. These ponds are attractive to herons, diving and dabbling ducks, and coots. The moderate to highly saline ponds attract primarily grebes, diving ducks, shorebirds, phalaropes, gulls, terns, and pelicans. Gill reported that pond A-9, between Alviso Slough and Coyote Creek, was one of the most valuable to avifauna in the South Bay. He estimated that approximately 80 percent of the wintering waterfowl in the Alviso area concentrated on this water intake pond in March 1971, and that large numbers of migrating willets, godwits, and long-billed curlews also made extensive use of this pond for feeding and resting. In general, Gill found that other low salinity intake ponds had similarly high avifauna values. The easterly unit of the Sunnyvale oxidation ponds, a freshwater pond, was also heavily utilized by waterfowl for feeding and resting.

The Basin Plan Alternative alignment does not cross any of the active South Bay salt ponds. Between Stations 23 and 32, it passes adjacent to highly saline ponds with relatively low ecological value (see Figure II-17). Between Stations 33 and 35.5, the alignment crosses an abandoned, dry salt pond owned by the U.S. Navy. This diked area is being developed as landfill and has virtually no biological value in its present state. North of the Ames Research Center, the alignment lies next to ponds A-2E and A-2W. The large saline pond to the south of the alignment, near Station 37, is heavily used by feeding and resting shorebirds and ducks. Between Stations 42.5 and 46, the route passes within 100 yards of the low salinity pond A-1 at the head of the Alviso series.

Dikes and Levees. The construction of the South Bay salt ponds required the installation of approximately 200 miles of dikes and levees. These salt pond levees, 60 percent of which are suitable for vehicular travel, provide extensive, relatively isolated habitat for salt marsh and salt-tolerant species of plants and for nest sites and refuge for birds and mammals. Gill (1973) reported that since construction of the levees and ponds, six species of birds, the Caspian and Forster's terns (which were not known to breed in the Bay previously), American avocet, black-necked stilt, snowy plover, and savannah sparrow, now commonly nest on dikes and levees. Other species nesting on the dikes include the killdeer and limited numbers of waterfowl. The levees also serve as retreats for small mammals such as the salt marsh harvest mouse during high water. The internal levees in ponds A-5, A-7, and A-8 are major nesting areas for American avocets, Forster's terns, and snowy plovers. Gill (1973) reported other American avocets and Forster's tern colonies on the pond A-1 levee adjacent to Charleston Slough. Burrowing owls nest in abandoned ground squirrel burrows in and around the levees in the International Telephone and Telegraph (ITT) tract south of Palo Alto Yacht Harbor (see Figure II-16). The losses of salt marsh habitat that resulted from the installation of salt pond dikes have been partially offset by the increase in the variety of bird life in the South Bay.

The Basin Plan Alternative would be placed within or immediately next to salt pond dikes between Stations 26.5 and 33 and Stations 36 and 39. Four levees would be breached within the Palo Alto Baylands Reserve. Waterfowl breeding has been reported by Gill (1973) on and near the dike between Stations 38 and 40. None of the other dikes coincident with the proposed route has been reported as being important breeding sites for South Bay wildlife.

Grasslands. The salt marsh habitat normally grades up into a grassland community, which has a diverse flora more or less typical of the uplands of central coastal California. Where salt ponds are interposed, the transition to the grassland may be abrupt. Because of the proximity of open water and marshes, the typical upland species component, including the blacktailed jack rabbit, California ground squirrel, California meadow vole, mourning dove, burrowing owl, redtailed hawk, and American kestrel, is supplemented by a number of foraging marsh birds, such as the great egret and great blue heron, and raptors, such as the marsh hawk and white-tailed kite. Several species of ducks nest in the seasonally wet grasslands in the Palo Alto Baylands Reserve. The total production of ducks each year is small, however.

Many of the South Bay grasslands have been cultivated, grazed, or otherwise disturbed in the past. These "old fields" are usually invaded by a variety of seed-bearing weeds and grasses that provide shelter and food for songbirds, gamebirds, and small mammals. Grasslands presently under cultivation have generally low wildlife values.

The Basin Plan Alternative alignment crosses grasslands, in one form or another, over much of its distance, as shown in Figure II-14. Those with the higher biological productivity are located in the Palo Alto Baylands Reserve area between Stations 51.5 and 53. The property is owned by ITT.

Streams and Sloughs. Seasonal runoff from the Santa Clara Valley and neighboring uplands enters the South Bay through a number of streams. The majority of these drainages have been channelized for flood control, and several have upstream impoundments which have greatly changed the discharge volumes and rates. Near the mouth of each stream tidal action becomes effective, producing estuarine sloughs with seasonally variable salinity. These sloughs provide diverse microhabits, including open water that ranges from brackish to estuarine, tidal flats, estuarine flats, and "eyebrows" (emergent vegetation in shallow water bordering the slough). These stream-edge plant communities grade from salt marshes in the tidal inundation zone to freshwater marsh-type species, such as bulrushes, tules, and cattails, in the regions above the tidal influence.

Open water in the sloughs is closely confined to a level below the 10-foot contour. Limited numbers of fish, such as striped bass, steelhead, smelt, perch, and bottom fish, forage in the sloughs. Some slough waters support small numbers of harbor seals and large numbers of wading birds, puddle ducks, and diving ducks. Other water birds feed in the shallow and exposed mud flats of the larger sloughs. The emergent vegetation provides cover near the mouths of the sloughs for species adapted to salt marshes and provides nesting and feeding habitats for birds such as redwinged blackbirds, coots, puddle ducks, and longbilled marsh wrens in the upstream sections.

Typical tidal sloughs in the study area include Alviso Slough (Guadalupe Creek) and Guadalupe Slough (Saratoga Creek). Artesian and Charleston Sloughs, on the other hand, are not typical tidal sloughs. Artesian Slough presently receives the wastewater discharge from the San Jose/Santa Clara wastewater treatment plant and has developed into a freshwater system through the first one-third of its length, or approximately 2,000 yards. Cattails and bulrushes growing in dense stands along the banks and on islands in the center of the channel provide shelter and nest sites for terrestrial and aquatic birds, such as snowy egrets, great blue herons, and black-crowned night herons. Snowy egrets have been nesting in the bulrushes since the spring of 1975. In addition, black-crowned night herons have established a rookery along the freshwater marsh in Artesian Slough. This rookery is one of only two heron rookeries in the South Bay (San Francisco Bay National Wildlife Refuge, personal communication, June 1978). The high advective flows of the wastewater discharge result in a lack of benthic community in Artesian Slough, reducing the value of the area to wading birds and other species that might feed in the mud flats of the freshwater portion of the slough, and while large quantities of bulrush and cattails do grow in the slough, these are not particularly valuable as a food source to the wading birds or to ducks. In addition, the slough waters consist entirely of the San Jose/ Santa Clara discharge for about 2,000 yards; this undiluted wastewater, and its toxicity (Section II.1.1), may severely limit the ecological potential of this slough.

The tidal flats near Coyote Creek are inundated only when the tide is in and are, as a result, estuarine or brackish water rather than freshwater systems (about 1,000 yards). They are characterized by lower-growing eyebrows of sedges and salt-tolerant plants. Bird species in this area are more typical of saltwater sloughs, and the benthic community is dominated by small annelid worms (see Station 11, Table II-11) typical of less productive mud flats.

A moderately severe incident of botulism occurred in Artesian Slough, Coyote Creek, and Mud Slough in the summer of 1975 (California Department of Fish and Game, personal communication, October 1975). Nearly 2,000 dead and dying waterfowl and shorebirds were picked up by state and federal wildlife agents between September 13 and October 23. About 85 percent were ducks, primarily pintails, shovelers, and green-winged teals. Again, in 1976, approximately 2,900 waterfowl died of botulism in the South Bay between September 1 and December 31. No large-scale incidents of botulism were reported in 1977 (California Fish and Game, personal communication, April 1978). These incidents were small compared to a 1974 botulism outbreak in the South Bay. Between September 1 and December 1 of that year, nearly 13,200 shorebirds and waterfowl were picked up dead, including eight California clapper rails. Over 3,000 dead birds were removed from the Sunnyvale oxidation ponds alone.

Avian botulism is caused by a toxin produced by the bacterium *Clostridium botulinum* (Type C), which thrives on decomposing protein. Birds will develop botulism by ingesting live or dead animal matter which contains the toxin. Occurrence of this bacterium and botulism is common in alkaline marshes.

In order for a large occurrence of botulism, certain ecological conditions must be present. With a peak dieoff of acquatic invertebrates, botulism bacteria will grow in the invertebrates. Ducks may ingest either the growing bacteria or bacteria spores with their food. If spores remain in the digestive tract, they will germinate and grow upon the death of the bird. Carcasses of birds will decompose in the water, providing a growth medium for other bacteria and maggots which feed on the carcasses. The maggots, which may in turn be ingested by birds, concentrate the botulism toxin. A botulism study conducted by RWQCB and California Fish and Game in 1977 (RWQCB, personal communication, June 1978) indicates that removal of waterfowl carcasses does appear to limit the spread of botulism by limiting the favorable environment for growth of the bacterium and accumulation of the toxin.

Botulism is endemic to most California marshes. It is not fully understood whether or not wastewater discharges aggravate the occurrence of botulism. Major botulism incidents greater than those reported for the South Bay have occurred in the San Joaquin Valley (1968-69), where other factors such as temperature, water level, and excess rainfall are thought to play a greater role than waste discharges alone (California Fish and Game, personal communication, April 1978; Hunter 1970; Hunter 1969; Hunter and Clark, undated; Parish and Hunter, 1969). However, conditions such as salinities below 30 ppt, low DO, and altered temperature regimes may be caused or aggravated by wastewater loadings, and, therefore, many outbreaks in the South Bay (Sunnyvale oxidation ponds, Coyote Creek) may be in part attributable to the presence of wastewater.

Guadalupe Slough receives the Sunnyvale effluent approximately two miles from the headwaters of the slough. Marsh grass eyebrows and exposed mud flats are characteristic downstream of the discharge and resemble other saltwater sloughs more than the freshwater Artesian Slough system. Avocets, coots, grebes, and other birds utilize the flats at low tide, usually in low to moderate numbers (Appendix I). Benthic biota are also dominated by annelid worms (Station 13, Table II-11) with species similar to the estaurine saltwater flats at the junction of Coyote Creek and Artesian Slough.

Palo Alto discharges to a man-made channel in the Baylands marshes, near the old channel of Mayfield Slough. This channel is dominated by a mixture of salt-tolerant and freshwater plants, such as saltbush, sedges, pickleweed, and cattails, with zonation of plants clearly defined by water level in the channel (Holmes, 1977). The freshwater plants are probably dependent on the Palo Alto discharge, although water in the channel is more brackish than fresh due to tidal influences. No flats are found along the channel, and bird life is dominated by ducks, coots, and grebes. Alameda song sparrows are common in the shrubs along the canal as are black-birds, white-crowned sparrows, and house finches. Benthic species are likely to be more sparse due to the high advective flows from the discharge pipe; no sampling was done in this channel for benthic species.

Charleston Slough, the other large slough which does not exhibit typical tidal slough characteristics has been isolated from the Bay by a dike (see Figure II-16). This slough receives heavy use from a wide variety of South Bay bird species and is a popular site for bird watching. Gill (1973) noted nesting on and adjacent to the slough by six species of ducks, Forster's tern, the long-billed marsh wren, savannah sparrow, and Alameda song sparrow. Uncommon species such as the white-tailed kites, the California least tern, and the California clapper rail are occasionally observed at the slough. The least tern, a species on the federal and state endangered species lists, can be frequently observed feeding in Charleston Slough.

The Basin Plan Alternative alignment crosses eight streams or sloughs (Figure II-14):

- Guadalupe Creek, Station 5
- Saratoga Creek, Station 8.25
- Calabazas Creek, Station 10
- Unnamed Creek, Station 15.25
- Stevens Creek, Station 37.5
- Mountain View Slough, Station 42.5
- Mayfield Slough, in the Palo Alto Baylands Reserve, Station 48.25
- Mayfield Slough, Station 51.5

Observations of wildlife activity at and near these points indicate only light use at all except Mayfield Slough in the Palo Alto Baylands Reserve. The first six streams have soft, clayey bottoms, which are unsuited for the development of a diverse benthic fauna. This lack of a food base keeps predator use low. Guadalupe Creek does provide recreational shrimp fishery, however, during some times of the year (Lane, personal communication, June 1978). Mayfield Slough has been reduced to a series of disconnected ponds and oxbows with the installation of dikes and a landfill. The section crossed by the Basin Plan Alternative alignment (Station 51.5) is isolated from all other surface waters, supports essentially no marsh vegetation, and is dry from mid-summer until the winter rains begin. Biological activity observed in the area of the slough crossing was very low. The section of Mayfield Slough in the Baylands Reserve is of much higher biological quality. Emergent vegetation is abundant, and ducks and coots were commonly observed in the area at all seasons.

Freshwater Marshes and Ponds. The least common type of habitat in the South Bay is the freshwater marsh.

In California, freshwater marshes have been reduced to one-third of their original area (Harvey, personal communication, June 1978) and approximately 95 to 99 percent of the freshwater marshlands in the Bay Area have been destroyed since the settlement of the area by the Spanish (Shellhammer, personal communication, June 1978). There are seasonal variations in salinity observed in many "freshwater" systems. Most of the freshwater marshes and ponds in the project area are located at the heads of tidal sloughs, such as Artesian Slough. In Mayfield Slough, saline residues in the soil are leached into the water and build up in the absence of flushing. Rainwater runoff dilutes the water of Mayfield Slough each winter, restoring the low salinity.

The freshwater marsh at the head of Artesian Slough is maintained by the constant discharge of effluent by the San Jose/Santa Clara water pollution control plant. It is the breeding area for the rare salt marsh yellowthroat and one of the few places in the Bay where ducks successfully raise broods (Shellhammer, personal communication, June 1978). In this slough are rookeries for snowy egrets, great blue herons, and black-crowned night herons as well. It is used as a study area by students at San Jose State University and other Bay Area schools.

A freshwater marsh on Ravenswood Point was formerly a privately owned duck club but will be in the Greco Island Unit of the San Francisco Bay National Wildlife Refuge. Annually, this diked marsh area is flooded with well water in early autumn. This freshwater flooding attracts migrating ducks to the impoundment area for rest and feeding. During the rest of the year, the marsh is dry, except for the deeper dredged channels next to the dikes. As a result of this annual freshwater flooding and the leaching of ground salts, both fresh and salt-tolerant plants and grasses grow within the marsh.

A small cattail marsh is located between Alviso and the San Jose/Santa Clara plant. Late summer drying eliminates standing water and precludes the development of a freshwater pond biota.

Freshwater marshes and ponds provide habitat for a variety of wildlife species that are poorly adapted, during some part of their life cycle, to saline water. These species include pintail, mallard, gadwall, cinnamon teal, shoveler, and ruddy ducks, the salt marsh yellowthroat, the sora rail, and the Virginia rail (Mewaldt, personal communication, June 1978). Young waterfowl, for example, will die from lack of fresh water. For this reason, nesting of waterfowl in the South Bay is limited, and most attempts fail. However, nesting of ducks has been reported in the Palo Alto Baylands Reserve, Charleston Slough, Mountain View Slough, and the westerly unit of the Sunnyvale oxidation pond. Gill (1973) reported significant waterfowl nesting in the ephemeral ponds south of the Basin Plan Alternative route between Stations 38 and 42. Thirteen broods of ducks, primarily mallards, were sited on the oxidation pond in summer 1975. Nesting probably occurred in Guadalupe Slough, which forms the southwestern border of the pond. Over 50 ducklings were observed during June 1978 on the oxidation ponds, Mayfield Slough, and in the Palo Alto Baylands Reserve.

The Basin Plan Alternative alignment passes near freshwater marshes at Stations 0.5, 48, and 50 (Figure II-14). With the exception of the margins of Mayfield Slough, which are fresh water in nature, the route intersects no freshwater marsh.

Species of Special Concern

The State of California and the U.S. Department of Interior have designated three species reproducing in the South Bay as "endangered" (California Department of Fish and Game, 1972, U.S. Department of the Interior, 1975). These species are:

- California least tern. Observed feeding in the vicinity of Charleston Slough and salt pond A-1 (Gill, 1973). Nesting is reported in the San Francisco Bay National Wildlife Refuge only on Bair Island. Another nesting site in San Francisco Bay is Bay Farm Island, near the Oakland Airport in the Central Bay.

- **California clapper rail**. Primary nesting areas along Ravenswood Slough, San Mateo County, and between Cooley Landing and the Palo Alto Municipal Airport, and secondary nesting areas along the dikes and sloughs from the Santa Clara County/San Mateo County boundary slough through Alviso Slough (Gill, 1973).

- **Salt marsh harvest mouse**. Critically low numbers in the *Salicornia* and *Spartina* marshes along the Baylands dikes and sloughs. Diking and landfill measures have contributed to habitat destruction. These factors, coupled with winter flooding and increased predation, and competition from house mice and Norway rats, have reduced South Bay populations to an extremely low level. Small mammal trapping surveys have identified populations at Dumbarton Point, Palo Alto Baylands Reserve, Greco Island, and Bair Island (Schaub, 1971: Wandolleck, 1975).

"Endangered species" are those recognized as being in immediate danger of extinction throughout all or part of their range. The local ranges of these species are presented in Figure II-18.

Some California brown pelicans, also endangered, overwinter in the Bay Area and have been sighted on salt ponds and open water stretches of the Bay. The American peregrine falcon, another endangered species, is very rarely reported in the area. Additional information on these species is presented in Table II-12.

In addition to these endangered species, a number of South Bay resident species and occasional visitors are of special concern. Among these are:

- **Alameda song sparrow** *(Melospiza melodia pusillula)*. The southern race is confined to South San Francisco Bay, where nesting occurs in salt marsh.

Table II-12

ENDANGERED SPECIES OF
SOUTH SAN FRANCISCO BAY

Endangered Species	Reason for Listing, Habitat Requirements	Endangered Species	Reason for Listing, Habitat Requirements
Salt marsh harvest mouse *Reithrodontomys raviventris raviventris* (endangered - California) (endangered - U.S.)	Loss of salt and brackish marshes by diking/landfill. Requires cover and higher ground to protect during high tides.	California least-tern *Sterna albifrons browni* (endangered — California) (endangered — U.S.)	Habitat destruction, habital disturbance, predation. Requires sandy beaches free from human disturbance to assure successful nesting.
California clapper rail *Rallus longirostris obsoletus* (endangered — California) (endangered — U.S.)	Highly specialized, unable to adapt to environmental change — bay fill, industrial pollution — nest predation by Norway rats. Requires abundant growth of cord grass, pickleweed, and good quality water supporting molluscs and other small invertebrates as food items found in the mud bottom sloughs (USDA, 1973, 1974)	California brown pelican *Pelecanus occidentalis californicus* (endangered — California) (endangered — U.S.)	Reproductive failure, thin-shell egg disease attributed to persistent pesticides, tourist disturbance of colonies in Mexico.
		American peregrine falcon *Falco peregrinus anatum* (endangered — California) (endangered — U.S.)	Reproductive failure, thin-shell egg disease attributed to persistent pesticides, collection of young from nests by falconers.

LEGEND

RARE OR ENDANGERED SPECIES

▨ — Salt Marsh Harvest Mouse (Transects with Captures, Schaub, 1971)
●–●–● (Wandolleck, In Print)
■ — California Clapper Rail – Primary Nesting Areas (Mid May) (Gill, 1973)
● — California Clapper Rail – Secondary Nesting Areas (June-July) (Gill, 1973)
▲ — California Least Tern – Feeding Area (Late April-July) (Gill, 1973)
▲▲▲ — California Least Tern – Nesting Area (Gill, 1973)
☰ — California Black Rail – Sightings 1973-74 (USFWS, 1975)

American Peregrine Falcon – Very Rare Visitor to Bay Area (USFWS, 1975); Eyries Reported for Livermore Area
California Brown Pelican – Seen Feeding on Salt Ponds, Bay Waters

SPECIES OF SPECIAL CONCERN

●●● — Alameda Song Sparrow – Transects (Gill, 1973) Occurs throughout South Bay in Suitable Habitat (Pickleweed Marsh)
□ — Western Burrowing Owl
○ — White-tailed Kite – Neting (Gill, 1973)
× — Marsh Hawk – Nesting (Gill, 1973)
American Osprey – Rare Summer and Fall Visitor (USDI, 1974)
— Western Snowy Plover – Nesting (Gill, 1973)

Northern Longbilled Curlew – Common in Marshlands, Mudflats Fall, Winter, Spring; Uncommon in Summer (USDI, 1974)
Prairie Falcon – One Territory (1971-72) Reported by Garrett and Mitchell (1973) in Coastal Range Foothills, Alameda Co.
Alaskan Shortbilled Dowitcher – Common in Marshlands, Mudflats Fall, Winter, Spring; Uncommon in Summer (USDI, 1974)
Pigeon Hawk – Rare in Fall, Winter (USDI, 1974)
Vagrant Shrew – Probably in Salt Marshes throughout South Bay Area

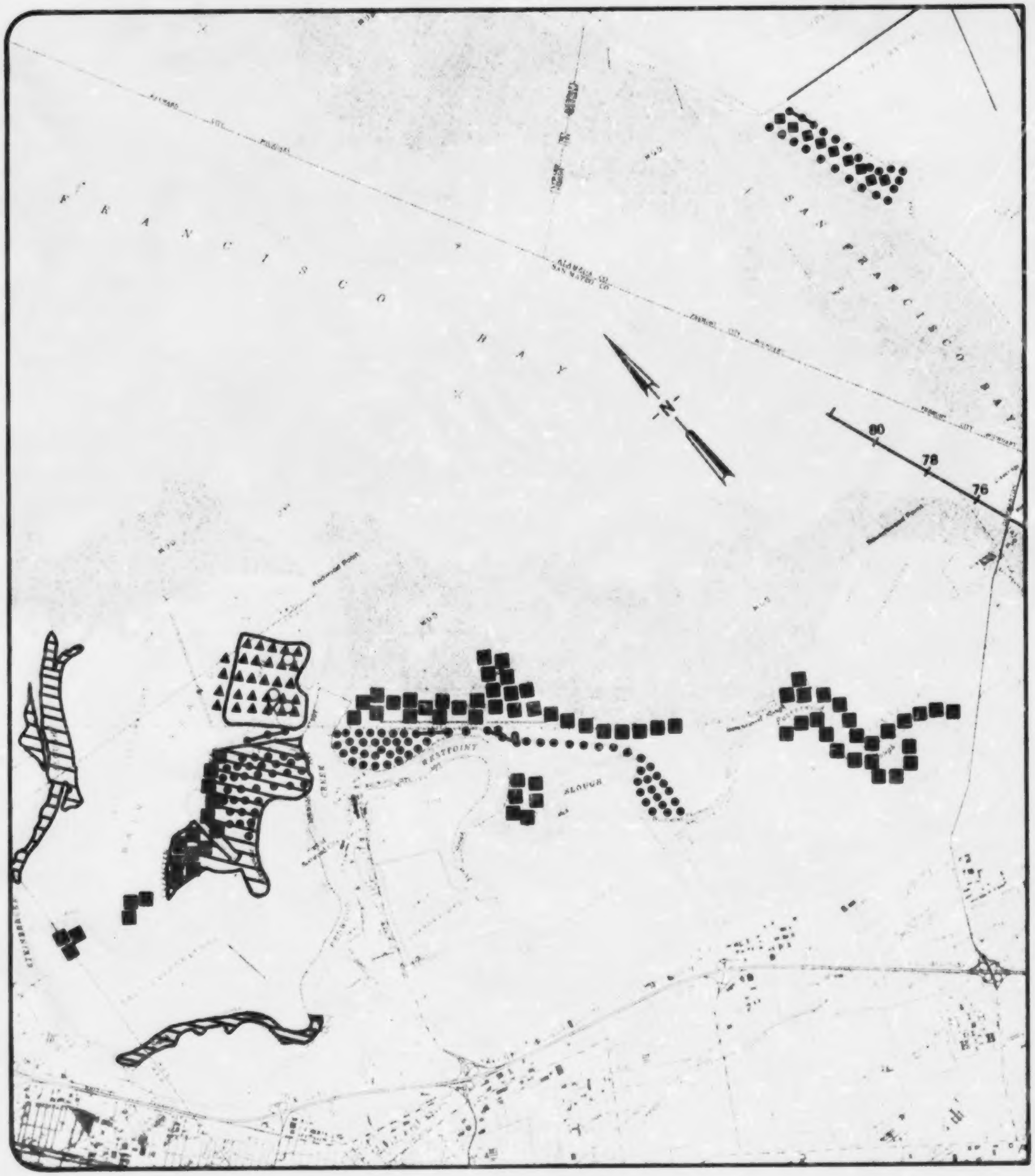
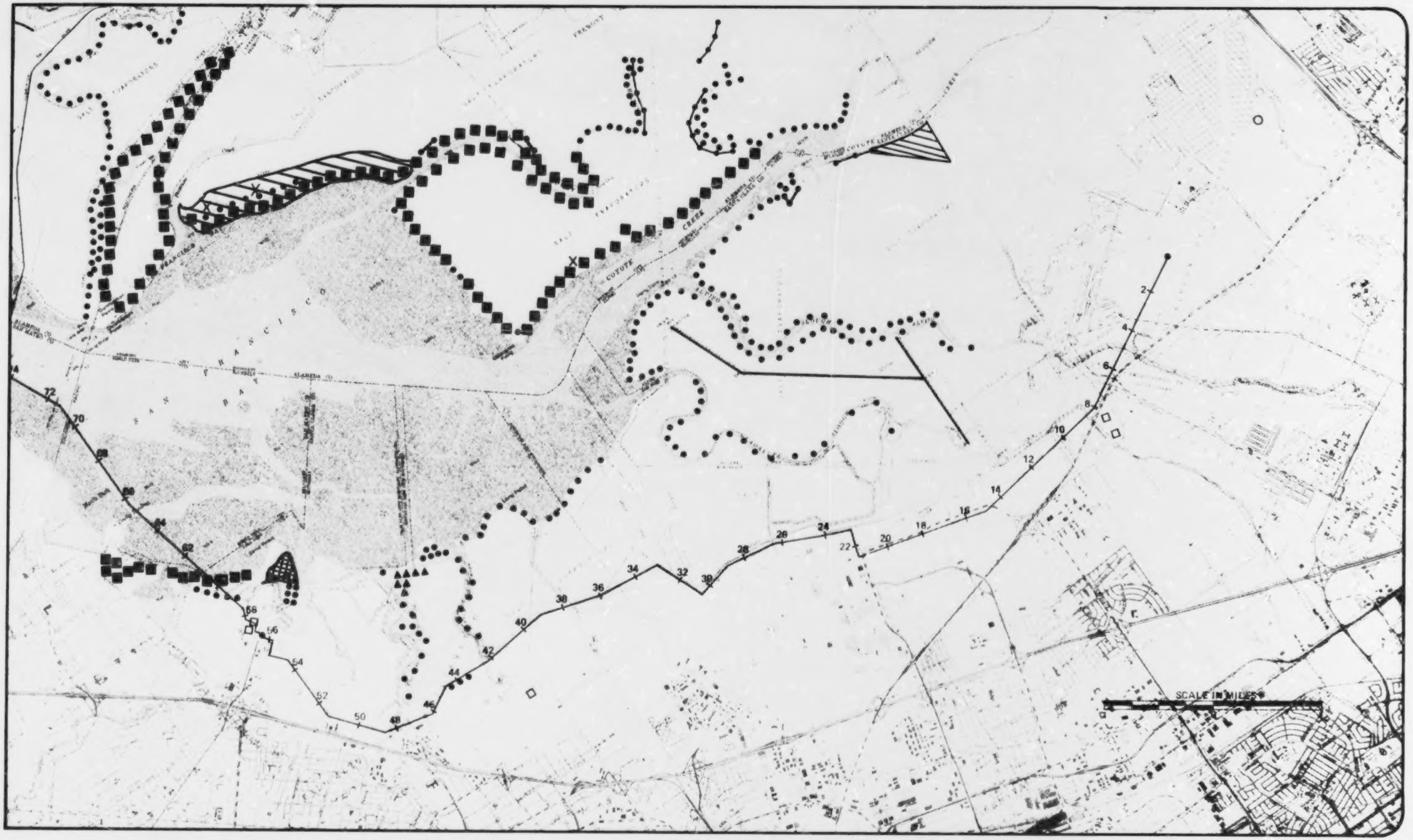


Figure II-18
RARE AND ENDANGERED SPECIES AND SPECIES OF SPECIAL CONCERN



SAN FRANCISCO BAY
COYOTE CREEK
FREMONT
SCALE IN MILES
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72

- Vagrant shrew *(Sorex vagrans)*. A small insectivore, active virtually 24 hours a day, feeding on salt marsh insects.

- White-tailed kite (*Elanus leucurus*). Locally common, but because of its restricted range, carries a fully protected status under California law.

- Marsh hawk (*Circus cyaneus*). Very rarely breeds in the Bay Area; nests in the freshwater marshes of the southeastern Bay Area. Occasionally observed foraging over the marshes of the South Bay.

- Bald eagle *(Haliaeetus leucocephalus)*. Rare winter visitor to area, classified as endangered throughout the continental U.S.

- Salt marsh yellowthroat *(Geothlypis trichas)*. Breeds only in freshwater and brackish water marshes, endemic race in Bay Area, proposed for listing as endangered in California (Harvey, Shellhammer, Mewaldt, personal communications, June 1978).

- California black rail *(Laterallus jamaicensis coturniculus)*. Reported from marshes of Plummer Creek, Triangle Marsh, Smith, Steinberger, and Cockscrew Sloughs (U.S. Fish and Wildlife Service, personal communication, 1975); a highly secretive small rail, which is fully protected under California law. Listed as rare.

- Western snowy plover *(Charadrius alexandrinus nivosus)*. Breeds in small numbers in the South Bay, including the dikes inside salt ponds A-5, A-6, A-7, and A-8.

- Long-billed curlew *(Numenius americanus)*. Feeds on mud flats; common in winter.

- Alaskan short-billed dowitcher *(Limnodromus griseus)*. Feeds on mud flats; common in winter.

- American osprey *(Pandion haliaetus)*. A rare fall and winter visitor to the Bay Area.

- Prairie falcon *(Falco mexicanus)*. A very rare, large falcon, which has undergone a marked reduction of population size in the last 20 years; persistent pesticides are suspected of increasing egg and chick mortality; one active eyrie (nest) reported in eastern South Bay in 1971 and 1973 (Garrett and Mitchell, 1973).

- Merlin *(Falco columbarius)*. A medium-size falcon of open areas; a rare fall and winter visitor.

- Western burrowing owl *(Speotyto cunicularia hypugaea)*. A locally common ground-nesting owl, which lives in the burrows of ground squirrels, frequently observed at Palo Alto Municipal Airport in grassy areas between aircraft taxiways; also reported from dikes around Palo Alto Baylands Reserve.

In addition, the popcorn flower (*Plogiobothrys dittusus*) may grow in this area and is relatively rare (San Mateo County Planning Department, personal communication 1974; Santa Clara County, 1973; USDI, 1975). These species, and others confined to marshlands in the South Bay, are threatened by continuing habitat destruction.

Though not endangered, harbor seals are protected by law in California. They have been seen in Corkscrew Slough and in Belmont Slough in San Mateo County (San Mateo County Planning Department, personal communication, 1974) and in west Guadalupe and Alviso Sloughs in Santa Clara County (San Francisco Bay National Wildlife Refuge, personal communication, April 1978). A large hauling ground has become established (over 200 seals) at Mowry Slough in San Mateo County (San Francisco Bay National Wildlife Refuge, personal communication, April 1978).

II.1.3 SOCIAL, ECONOMIC, AND CULTURAL ENVIRONMENT

As shown in Figure I-1, the study area is defined as that portion of Santa Clara County within the geographical boundaries of the South Bay Dischargers Authority, east of the Bayshore Freeway (U.S. 101). Also included in the study area is that portion of San Mateo County slightly north of the Santa Clara County line, east of the Bayshore Freeway, and south of the San Mateo Bridge. Data for this area of San Mateo County have been incorporated into portions of the report because of the area's proximity to the discharge point north of the Dumbarton Bridge.

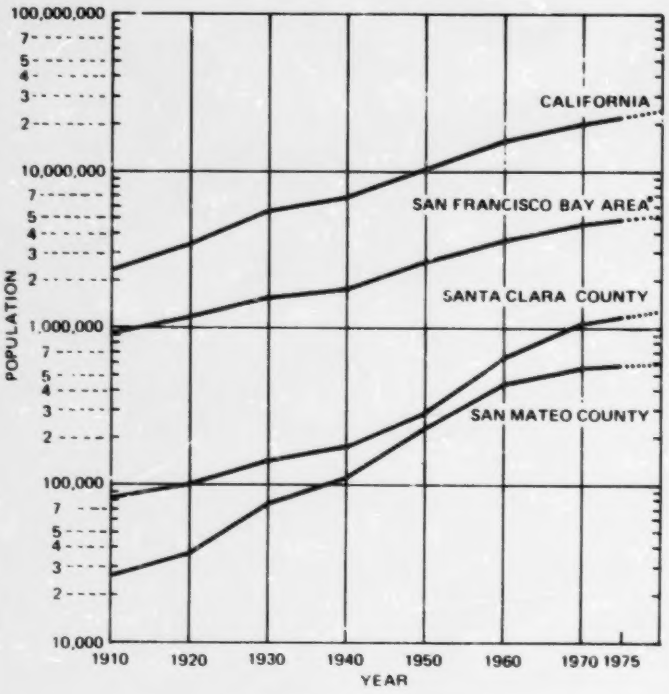
The Baylands area of South San Francisco Bay is defined for this report as that area from the Bay shoreline up to the 10-foot contour above mean sea level. The Baylands portion of the study area represents the general location of possible alternative routes of the Basin Plan Alternative.

Population and Demography

In Table II-13 and Figure II-19, historical population growths for Santa Clara and San Mateo Counties are compared with population growth in California and in the nine-county San Francisco Bay Area.

Santa Clara County population growth lagged behind state growth between 1900 and 1940, as shown by the declining percent of state population in each decade. However, since 1940 growth has been more rapid in the county than in the state. From 1940 to 1960, Santa Clara County population increased at an average annual rate of 13.82 percent. Since 1960, the average annual growth rate in the county has declined to 5.4 percent. The county had a 1975 population of 1,169,006 as determined by a special county census, and a State Department of Finance projection places the 1977 population at 1,202,100.

The large population increases during the post-World War II period are attributable to the influx of manufacturing industries into the county. Relative growth can



* San Francisco Bay Area includes: Alameda, Contra Costa, Marin, Napa, Sonoma, San Mateo, San Francisco, Santa Clara, and Solano Counties.

SOURCE: U.S. Bureau of the Census, Dept. of Commerce and California Department of Finance Population Research Station.

Figure II-19

POPULATION GROWTH IN CALIFORNIA, SAN FRANCISCO BAY AREA, AND SANTA CLARA AND SAN MATEO COUNTIES, 1910 - 1975

also be seen in comparative ratios computed for California and the San Francisco Bay Area between 1900 and 1975. In 1975, there were 14 times more people in California and seven times more people in the San Francisco Bay Area than there were in 1900. In Santa Clara County the population was 20 times larger in 1975 than in 1900.

San Mateo County also experienced its greatest rate of growth between 1940 and 1960. With an average annual growth rate of 9.2 percent during the 1940 to 1960 period, the county increased its share of California population from 1.6 percent in 1940 to 2.8 percent in 1960. The growth rate has declined to an annual average of 1.9 percent during the 1960 to 1975 period. In 1975, the population of 573,000 ranked ninth in the state and was 47 times larger than it was in 1900. Recent population estimates by the State Department of Finance (1977) show an increase of 11,600 people, for a county total of 584,600 for January 1, 1977.

An important factor in the declining population growth rate in San Mateo County since 1960 is the attraction of San Mateo County residents to large residential and industrial developments in adjacent Santa Clara County.

Observations of population density changes over the 1900 to 1975 period for Santa Clara and San Mateo Counties are also presented in Table II-13. In 1975, Santa Clara and San Mateo Counties ranked sixth and fifth, respectively, in the state in terms of population density.

ABAG/MTC provisional Series 3 estimates indicate that Santa Clara County is expected to have the largest absolute growth in population in California between 1975 and 1990 (ABAG/MTC, 1977-78).

Table II-14 presents population data for the cities in Santa Clara and San Mateo Counties within the SBDA service area and the San Mateo County study area. The SBDA service area includes the hydrographic regions No. 43 (Palo Alto) and No. 46 (San Jose), as defined in the Basin 2 study by the State Water Resources Control Board (1974). In San Mateo County, the study area is that area north of the Santa Clara County line, east of the Bayshore Freeway (U.S. 101), and south of the San Mateo Bridge. Figure I-1 presents the areal extent and location of the SBDA service area. Ninety-seven percent of the Santa Clara County population was located in the study area in 1975. Population has increased slightly in these areas but the proportions of population in the Service Area for SBDA and the San Mateo County study area remains the same in 1977.

Population projections used as the basis for sizing the Basin Plan Alternative were developed by the State Department of Water Resources (DWR) in cooperation with the State Department of Finance (DOF, 1974) and the Association of Bay Area Governments/Metropolitan Transportation Commission (ABAG/MTC, 1974). Two projection series have been utilized in this report — D/150 and E-zero. The D/150 series represents population projections based on growth patterns that have occurred between 1960 and 1970, with the highest share of Bay Area growth continuing in the South Bay counties.

Population projections (Table II-15) used for the SBDA service area were provided for that portion of Santa Clara County within Hydrographic Basin 2 (SWRCB and RWQCB, 1974). This area closely approximates the SBDA service area in Santa Clara County.

Both the DOF/DWR (1974) and the ABAG/MTC (1974) projections are provided to show the range within which future populations are expected to grow. The DOF/DWR projections are derived from a cohort survival population projection model which bases projections on birth and migration rates in the county. The D/150 series assumes a continuation of recent trends in birth and migration rates (fertility of 2.5 births per female in her lifetime; in-migration of 150,000 per year), while the E-zero series assumes a decrease (fertility of 2.1 births per female in her lifetime; in-migration of zero). The ABAG/MTC projections are based on regional employment levels shifting from a high growth rate in the South Bay (Grosouth, D/150) to a low growth rate (Losouth, E-zero).

Table II-13

POPULATION AND DENSITY GROWTH IN CALIFORNIA, SAN FRANCISCO BAY AREA, SANTA CLARA COUNTY, AND SAN MATEO COUNTY, 1900-1977

(U.S. Bureau of the Census, Dept. of Commerce; California Department of Finance, Population Research Section)

Year	1900	1910	1920	1930	1940	1950	1960	1970	1975	1977
California										
Population (1,000's)	1,485.1	2,377.5	3,426.9	5,677.3	6,907.4	10,586.2	15,863.0	19,703.0	21,198.1	21,742.08
1975/1900 Ratio									14.6	
Population Increase		892.4	1,049.4	2,250.4	1,230.1	3,678.8	5,276.8	3,840.0	1,327.0	
Percentage Change		60.0	44.1	65.7	21.7	53.3	49.8	24.2	6.7(4)	
Bay Area(1)										
Population (1,000's)	658.0	927.7	1,183.0	1,578.1	1,734.4	2,681.3	3,676.2	4,519.2	4,847.5	4,909.2
1975/1900 Ratio									7.37	
Population Increase		267.7	257.3	395.1	156.3	946.9	994.9	843.0	327.4	62.6
Percentage Change		40.7	27.8	33.4	9.9	54.6	37.1	22.9	7.2(4)	
Santa Clara County										
Population (1,000's)	60.2	83.5	100.7	145.1	175.0	290.0	658.7	1,074.1	1,193.4	1,202.1
1975/1900 Ratio									19.82	
Population Increase		23.3	17.2	44.4	29.9	115.5	368.2	415.4	119.3	
Percentage Change		38.7	20.6	44.9	20.6	66.0	126.7	63.1	11.1(4)	
Percentage of California Population	4.05	3.51	2.94	2.56	2.53	2.74	4.15	5.43	5.67	
Density(2) (pop./mi^2)	46.3	64.2	77.5	111.6	134.6	223.5	506.7	826.2	918.0	
San Mateo County										
Population (1,000's)	12.1	26.6	36.8	77.4	111.8	235.7	444.4	556.2	573.9	584.6
1975/1900 Ratio									47.43	
Population Increase		14.5	10.2	40.6	34.4	123.9	208.7	111.8	17.7	
Percentage Change		119.8	38.3	110.3	44.4	110.8	88.5	25.2	3.2(4)	
Percentage of California Population	0.8	1.1	1.1	1.4	1.6	2.2	2.8	2.8	2.7	
Density(2) (pop./mi^2)	27.1	59.5	82.3	173.1	250.1	527.3	994.2	1,244.3	1,283.9	

Notes:

(1) The San Francisco Bay Area includes the Counties of Alameda, Contra Costa, Marin, Napa, Sonoma, San Mateo, San Francisco, Santa Clara, and Solano.
(2) Density in actual population, land area: Santa Clara County, 1,300 mi^2, San Mateo County, 447 mi^2.
(3) Estimates of current population, California Department of Finance.
(4) Percentage changes over 5-year period 1970-1975 (estimate).

Table II-14

JANUARY 1, 1977 POPULATION ESTIMATES FOR SANTA CLARA AND SAN MATEO COUNTY CITIES WITHIN THE SBDA SERVICE AREA AND THE SAN MATEO COUNTY STUDY AREA

(Population in Thousands)

	Land Area (mi^2)	Total Population in City[1]	Percentage of Total County Population	Population in above Area[2]	Percentage County Total	Percentage City Total
Santa Clara County						
Palo Alto	25.2	54.9	4.4	54.9	4.5	100.0
San Jose	147.2	575.1	45.9	575.1	47.8	100.0
Mountain View	11.1	55.8	5.0	55.8	4.6	100.0
Los Altos	6.5	26.2	2.2	26.2	2.1	100.0
Los Altos Hills	9.5	7.2	0.6	7.2	0.6	100.0
Santa Clara	18.5	83.8	7.3	83.8	7.0	100.0
Cupertino	7.8	22.9	2.1	22.9	1.9	100.0
Campbell	4.7	25.3	2.5	25.3	2.1	100.0
Milpitas	9.4	32.3	2.7	32.3	2.7	100.0
Sunnyvale	22.9	105.0	8.9	105.0	8.7	100.0
Other Cities and Rural Areas	1,049.2	213.6	18.4	193.69	16.05	90.68
Total	1,312.0	1,202.1	100.0	1,182.2	97.[illegible]	
San Mateo County						
East Palo Alto	2.2	17.7	3.0	14.7	2.50	83.3
Redwood City	20.5	54.7	9.3	1.9	0.32	3.4
Belmont	4.6	25.5	4.3	0	0.00	0
San Mateo	11.3	79.0	13.6	2.0	0.30	2.5
San Carlos	4.6	26.8	4.5	1.0	0.20	3.8
Menlo Park	12.1	26.3	4.5	4.6	0.79	17.4
Foster City	3.7	20.8	3.5	20.8	3.56	100.0
Atherton	3.0	7.7	1.3	0	0	0
Other Cities and Rural Areas	383.0	326.1	55.7	0	0	0
Total	447.0	384.6	100.0	45	7.71	

Notes:

(1) California Department of Finance, 1977.

(2) SBDA service area; Hydrographic Regions 43 and 46 of Basin 2, SWRCB and RWQCB (1974).
San Mateo County Study Area: east of Bayshore Freeway (U.S. 101), north of Santa Clara County line, south of San Mateo Bridge.

Table II-15

PROJECTED POPULATION IN THE SANTA CLARA COUNTY PORTION OF THE SBDA SERVICE AREA(1)

(Population in Thousands)

	1970	1980	1990	2000
DOF/DWR				
D/150	1,041.0	1,348.0	1,697.0	1,909.0
E-zero	1,041.0	1,273.0	1,507.0	1,635.0
ABAG/MTC				
D/150	1,033.8	1,268.6	1,528.2	1,751.3
E-zero	1,033.8	1,203.7	1,360.1	1,422.8

Note:

(1) That portion of Santa Clara County included in the SWRCB Basin 2, Hydrographic Regions 43 and 46. This area closely approximates the SBDA service area (DOF/DWR, 1974; ABAG/MTC, 1974).

In the 1970 to 2000 projection period, the population of the service area in Santa Clara County is assumed to grow at an average annual rate of 2.8 and 1.9 percent for the D/150 and E-zero series, respectively.

Population projections for that portion of San Mateo County within the study area have been adopted from the ABAG/MTC *Summary of Series 2 Population Projections* (February 1974). The projections for the area are equivalent to the D/150 and E-zero series, designated "Grosouth" and "Losouth," respectively. The ABAG/MTC projections were used due to the delineation of zones approximating the San Mateo County portion of the study area. ABAG/MTC zones 74, 75, and 84 were aggregated to derive the projections in Table II-16.

Table II-16

PROJECTED POPULATION IN THE SAN MATEO COUNTY PORTION OF THE STUDY AREA(1)

(ABAG/MTC Joint Land-Use Transportation Planning Program, Summary of Series 2 Projections, February 1974)

(Populations in Thousands)

	1970	1975	1980	1990	2000
D/150 (Grosouth)	35.3	(43.3)(2)	47.5	67.7	94.6
E-zero (Losouth)	35.3	(43.3)	42.5	53.1	64.6

Notes:

(1) That portion of San Mateo County north of the Santa Clara County line, east of the Bayshore Freeway (U.S. 101), and south of the San Mateo Bridge.

(2) Estimated 1975 population from current DOF population data.

In 1977, the California DOF revised its E-zero projections, based on estimates of county populations for July 1, 1976. In Santa Clara County, the 1980 E-zero declined by 2,300, the 1990 E-zero by 80,900, and the 2000 E-zero by 74,300. Similar declines were also estimated for the San Mateo portion of the study area.

New ABAG/MTC estimates were made in March 1977 and revised in March 1978. These Provisional Series 3 Projections were based on two sets of assumptions, resulting in two sets of projections — one higher and one lower than the DOF E-zero projects. These revisions reflect recent declines in average household size, migration rates, and regional employment growth.

Recreation and Scientific Uses of the Area

Recreational uses of the Baylands of Santa Clara and San Mateo Counties are currently being developed through numerous projects. Historically, the area has been relatively inaccessible to the public due to the marsh and tidal lands and limited access due to industrial land holdings. However, due to the transition of many marshes into landfills, county and city projects have been implemented to develop large portions of the area for recreational use.

The San Francisco Bay National Wildlife Refuge, as described in Section II.2.1, currently covers over 21,500 acres of salt ponds, salt marsh, mud flats, and sloughs in Santa Clara, San Mateo, and Alameda Counties (Figure II-20). Eventually, it will cover approximately 23,000 acres. In addition, Baylands recreational parks are being planned and developed by Sunnyvale and Mountain View. The Sunnyvale park is to be located north of the site of the current Sunnyvale treatment plant. The Mountain View park is being developed between Mountain View Slough and Stevens Creek on a sanitary landfill. Upon completion, the park will include facilities for sailing, picknicking, golf, and fishing. Portions of the Palo Alto Baylands are under consideration for development. A smaller area surrounded by Mayfield Slough would be inundated by breaching the outboard dikes, allowing it to return to its natural salt marsh state.

Numerous small boat harbors are located within the Baylands, with access to the Bay for motor- and sailboats at Alviso, Palo Alto Yacht Harbor, the Port of Redwood City, Redwood Shores, and Foster City. Limited fishing is enjoyed in the South Bay (see Section II.1.2), as is duck hunting in the freshwater marshes during the hunting season.

Other popular recreational uses in the Baylands include golf, horseback riding, and motorcycle racing. Golf courses in the area include Fairway Glen Golf Course on Santa Clara-Alviso Road, Moffett Field Golf Course (for military personnel only), and Palo Alto Municipal Golf Course located immediately south of the Palo Alto Municipal Airport. Private horseback riding and boarding facilities are located at the Mountain View-Alviso Freeway and Caribbean Road interchange, and a temporary motorcycle race track is located on Caribbean Road, immediately east of the Sunnyvale treatment plant.

Additional recreational areas include the Palo Alto Athletic Center on the southern boundary of the Palo Alto Municipal Golf Course and Marine World/Africa U.S.A. amusement park in San Mateo County off U.S. 101 at Ralston Road. The Marriott Great America amusement park is also located in the Baylands of Santa Clara County.

The San Francisco Bay National Wildlife Refuge also offers a unique opportunity for study of Bay ecosystems, and it is utilized by nearby schools for this purpose. The Artesian Slough area is being studied by personnel from the South Bay Institute for Avian Studies (Rigney, personal communication, June 1978), and students from University of San Francisco and San Jose State University utilize the Palo Alto Baylands Reserve (Holmes, 1977; Wandolleck, 1975) for class and thesis projects.

Archaeological, Paleontological, Historical, and Cultural Resources

Archaeological Resources. Maps and records on file at the Society for California Archaeology clearing house indicate that there are a number of known archaeological resources within the region of the Basin Plan Alternative. Investigations performed by Archaeological Consulting and Research Service (ACRS) have shown, however, that there are no known archaeological resources within the Basin Plan Alternative alignment. In addition, no indications of archaeological remains were observed or discovered during field reconnaissance by ACRS in 1975 (Appendix J). No concentrations of shell, baked clays or fire cracked rock, soil color changes, vegetation changes, faunal or lithic materials, artifacts, or any other indicators that may signify the presence of archaeological resources were encountered. This does not, however, preclude the possibility of subsurface archaeological resources within the proposed alignment. A number of archaeological resources have recently been discovered along the San Francisco Bay that have, through time, been covered by thick dune, stream, and estuary deposits.

A discovery of archaeological significance was made in 1951 in the immediate vicinity of the Basin Plan Alternative. During summer of that year, construction activities related to the development of a subdivision in East Palo Alto exposed a large number of human burials at depths ranging from 3.5 to 6.5 feet. Archaeological investigations by Dr. Bert A. Gerow of Stanford University revealed cultural remains suggesting the existence of a large village complex that had been buried under alluvial materials from San Francisquito Creek. Materials from the site, which have been designated as SMa-77, yielded a radiocarbon date of 1200 B.C. (Gerow, 1968).

Of interest to this study is the fact that the village complex was once situated on the natural levee of San Francisquito Creek, which at the present time is more than a mile away from archaeological site SMa-77. Helley and Brabb (1971) and Lajoie et al. (1974) have prepared maps of the alluvial deposits associated with San Francisquito Creek as well as a number of other areas that contain similar materials. Designated as Qyfo and Qyf deposits of the late Cenozoic in Figure II-21 (colored yellow), they are described by Lajoie et al. (1974) as being, respectively, fine grained younger alluvial fan deposits, consisting of unconsolidated, moderately-sorted, moderately-permeable fine sand and coarse grained younger alluvial fan deposits, consisting of unconsolidated, moderately sorted permeable sand, and silt with coarse sand and gravel becoming abundant toward fan heads and narrow canyons. Qyfo deposits vary in thickness from 0 to 12 feet, and Qyf deposits vary from less than 10 feet to as much as 50 feet. Qyf deposits "locally contain aboriginal artifacts and skeletal remains." Both deposits are presently forming with the oldest deposits probably dating back 5,000 to 7,000 years.

The Qyfo and Qyf deposits mark old stream channels along which sites like SMa-77 are located. As such it is important to note that a number of Qyfo deposits are shown in Figure II-21 to be intersecting with or near the proposed alignment. Those Qyfo deposits that are overlain by Qobm deposits (actually Qym deposits or young Bay Mud, Lajoie, personal communication, 1975) most likely continue under the young Bay Mud and cross the alignment route. These areas of Qyfo and Qyf deposition should be considered as having a high probability for containing subsurface or buried archaeological resources.

Paleontological Resources. The paleontological resources of the margins of the present San Francisco Bay have not been the focus of geological investigations until recent attempts were made to map and define late Cenozoic (particularly late Quaternary) sediments along the Bay margins (Helley and Brabb, 1971; and Lajoie et al., 1974). Paleontological discoveries have been made adjacent to the present study area along San Francisquito Creek (Santa Clara County Planning Department, 1973) and in the marshlands near Sunnyvale (Lajoie et al., 1974).

Of particular interest to the present study is the recent paper by Helley, Adam, and Burke (1972), "Late Quarternary Stratigraphic and Paleoecologic Investigations in the San Francisco Bay Area," which describes biostraitigraphic studies conducted at the Mountain View sanitary landfill. Sanitary landfill operations at the dump have exposed a varied and rich fossil flora and fauna of late Pleistocene and Holocene age (Helley, Adam, and Burke, 1972).

Historical and Cultural Resources. An "Inventory of Historic Landmarks, Santa Clara County," compiled by the County Planning Department in 1962, listed 130 historical landmarks of various types existing in the county. The inventory included Indian village sites (mounds and middens), the several sites of Mission Santa Clara, several adobe buildings dating before 1850, and many residential and other noteworthy structures dating from about 1850. Since 1962, 24 of these historic landmarks have been designated as Registered California Historic Landmarks, while seven have been included in the *National Register of Historic Places*. None of these is locat-

LEGEND

■ San Francisco Bay National Wildlife Refuge

■ Parks, Reserves, and Recreation Areas

1. Santa Clara Valley Floor Park (proposed)
2. Sunnyvale-Santa Clara Baylands Park (proposed)
3. Mountain View Shoreline Park (under construction)
4. Palo Alto Baylands Reserve (existing)
5. Palo Alto Yacht Harbor (existing)
6. Palo Alto Municipal Golf Course (existing)
7. Menlo Park Baylands Area (proposed)

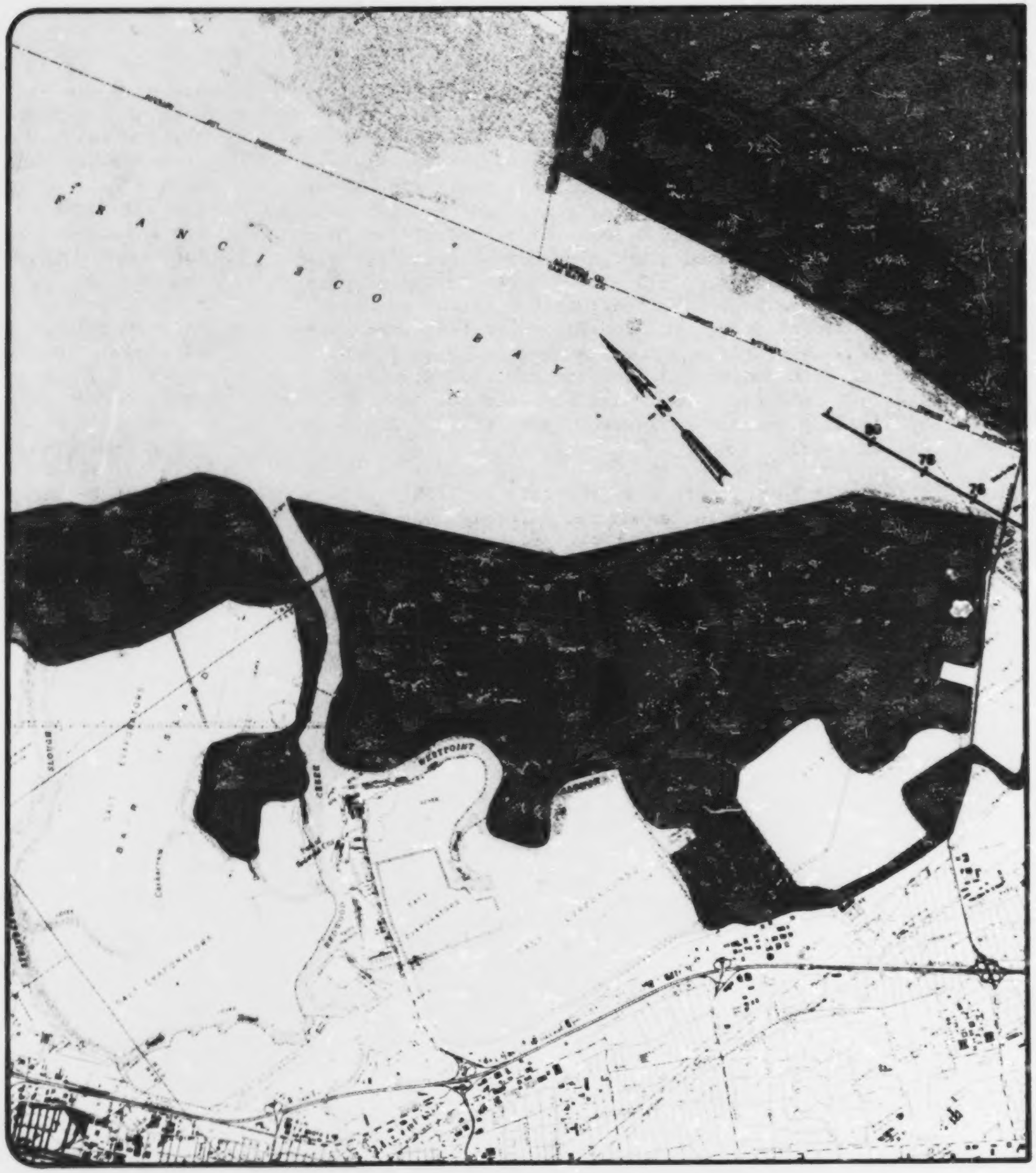
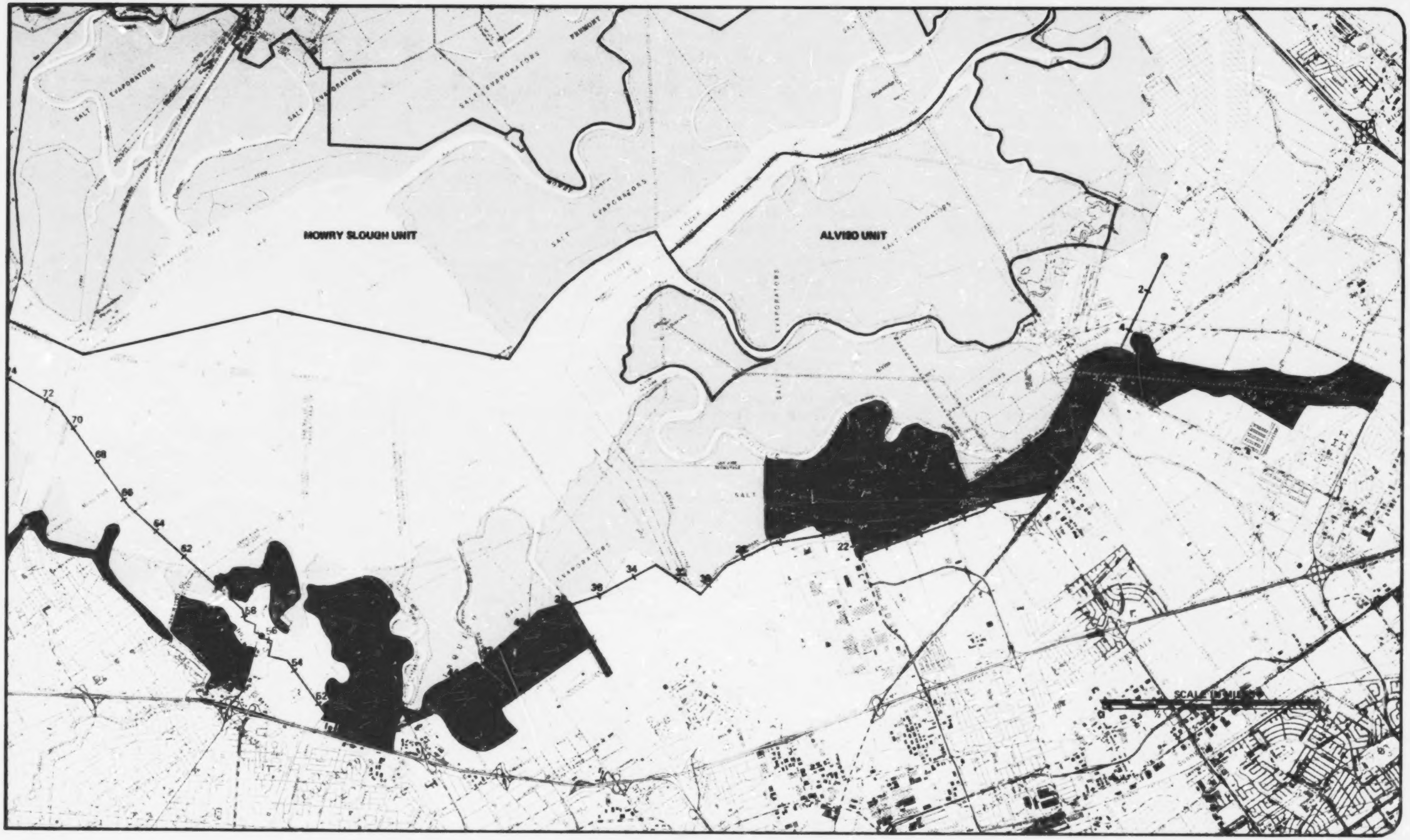


Figure II-20
WILDLIFE REFUGE,
PARKS AND RECREATION AREAS


MOWRY SLOUGH UNIT
ALVISO UNIT
SALT EVAPORATORS
74
72
70
68
66
64
62
58
56
54
52
38
36
34
32
30
28
22
4
2
SCALE IN MILES
½

ed within the Basin Plan Alternative alignment, and in fact, 22 of the 130 historic structures identified in 1962 have been demolished. In 1973, the County Board of Supervisors established the County Historic Heritage Commission to preserve and protect the remaining historic structures in the county (Santa Clara County Planning Department, 1973).

Section 2(a) of Executive Order 11593, "Protection and Enhancement of Cultural Environment," dated May 13, 1971, required that federal agencies locate, inventory, and nominate eligible historic, architectural, and archaeological properties under their control or jurisdiction to the *National Register of Historic Places*. EPA will work closely with the State Historic Preservation Officer to assure that the provisions of this section of the Executive Order are carried out.

Section 1 (3) of E.O. 11593 requires that federal agencies establish procedures regarding the preservation and enhancement of non-federally owned historic, architectural, and archaeological properties in the execution of their plans and programs. Section III of this EIS includes discussion of probable impacts of this project on such properties and measures to mitigate these impacts.

A discussion of the history of the study area and significant historical sites along the proposed alignment is presented below. The areal location of historical landmarks and sites referred to in this section are presented in Figure II-22.

Before caucasians inhabited the area, the Santa Clara Valley was occupied by Ohlone and Costanoan Indians. Migrating from Asia during the last 10,000 years, these groups congregated in the Santa Clara Valley area. Two Indian village sites with associated middens dating back to 1700 A.D. have been located in the study area (A and B in Figure II-22).

The establishment of Mission Santa Clara by Spanish missionaries in 1777 marked the beginning of Caucasian occupation of the valley. In the early 1800's, the only signs of civilization in the valley, aside from the buildings associated with the early mission, were large land grants known as ranchos. These tracts, unsurveyed and devoted to cattle raising, ranged in size from about 200 to 40,000 acres. All of these rancho land grants or concessions, made before California took allegiance to Mexico in 1822, were Spanish. Between 1822 and July 7, 1846, when California became a United States Territory, all grants were Mexican. The Basin Plan Alternative alignment passes through several of the old Rancho grants. Beginning from the San Jose/Santa Clara water pollution control plant and moving in a westerly direction (Figure II-22), the Rancho grant properties parallel to or traversing the Basin Plan Alternative route are:

- Rancho Rincon de los Esteros — 6,353 acres granted to Ygnacio Alviso in 1838.
- Rancho Embarcadero de Santa Clara — 196 acres granted to Barcilia Bernal in 1845, the area was used as a landing for barges on the Guadalupe River.
- Rancho Ulistac — 2,217 acres granted to two Santa Clara Mission Indians, Marcelo Pio and Cristobal in 1845.
- Rancho Pastoria de las Borregas — 9,066 acres granted to Francisco Estrada in 1842.
- Posolmi — 1,696 acres granted to Yñigo, chief of an Indian tribe inhabitating the land now occupied by Moffett Field, in 1844.
- Rancho Rincon de San Francisquito — 8,418 acres granted to Jose Pena in 1841.
- Rancho Rincoñada del Arroyo de San Francisquito — 2,230 acres granted to Mara Antonia Mesa in 1841.
- Rancho Pulgas — major portion of southeastern San Mateo County, approximating current city limits of Redwood City and Atherton.

In all of these areas, cultural artifacts could be encountered during project construction.

Around the time California became a United States Territory in 1846, American settlers migrated into the valley and established homesites and claims on the lands previously granted to the Spanish and Mexicans. Disputes over rightful claims and litigation over ownership of lands became commonplace, continuing until the early 1900's (Arbuckle and Rambo, 1968).

Eleven locations of landmarks, sites, and residences of historic interest built and used by the early American settlers have been identified in the Basin Plan Alternative area and are shown in Figure II-22. These are:

(1) The William Zanker House — a two-story residence built in the 1860's north of Highway 237 on the west side of Zanker Road.

(2) Freight Storage and Repair Station — located at 6057 El Dorado Street in Alviso; the station was used by Wade Stagecoach Line in the late 1800's, when Alviso was a major port for Santa Clara Valley agricultural products.

(3) D.K. Tilden House — the two-story house, located at 970 Elizabeth Street in Alviso was built in the 1860's.

(4) The Alviso Depot — built for the South Pacific Coast Railroad in the 1870's, the depot is located on Elizabeth Street in Alviso (San Jose Historic Landmark Commission, 1975).

(5) McCubbins' Landing — northeast of Caribbean Road, on the Old Guadalupe Slough, 1897.

(6) Jagel's Landing — located on the Mountain View Shoreline Park development, 1897.

(7) Guth's Landing — located east of the decommissioned Mountain View sewage treatment plant, 1897.

(8) Rengstorff House — located on Stierlin Road, the house was built in the 1850's by Rengstorff family and furnished with articles shipped from Europe (Mrs. J. Holtzclaw, Mountain View Library, personal communication, October 1975).

(9) Mountain View Landing — located just east of the decommissioned Mountain View sewage treatment plant, 1897.

(10) Clark's Landing — located near the ITT property boundary on the former end of Mayfield Slough, 1897.

(11) Wilson's Landing — located at the northern boundary of the Palo Alto sewage treatment plant near the Palo Alto Yacht Harbor and Palo Alto Municipal Airport, 1897 (Nichols and Wright, 1970).

Many of these historical sites have been covered by landfill, levee construction, salt evaporators, or industrial developments. However, the Basin Plan Alternative route either parallels or coincides with the approximate locations of these historic sites, and the mitigation for the salvage or preservation of these sites should be initiated if they are encountered during construction.

Visual and Aesthetic Setting

The Baylands is characterized by low saltwater and freshwater marshes, sloughs, salt ponds, open fields, mud flats, sanitary landfills, sewage treatment plants, and residential, industrial and agricultural developments. Land reclamation practices during the last century have filled about 70 percent of the area, with very few areas remaining in their natural state.

The estuarine sloughs and marshes, where fresh water from the Santa Clara Valley and the Santa Cruz and Diablo Mountain ranges enters the saltwater of San Francisco Bay, make the area somewhat unique in its

LEGEND

ARCHAEOLOGICAL – PALEONTOLOGICAL (LATE CENOZOIC DEPOSITS)

▭ Qyfo

■ Qobm

■ Qyfo – Not in contact with pipeline route

■ Qyf

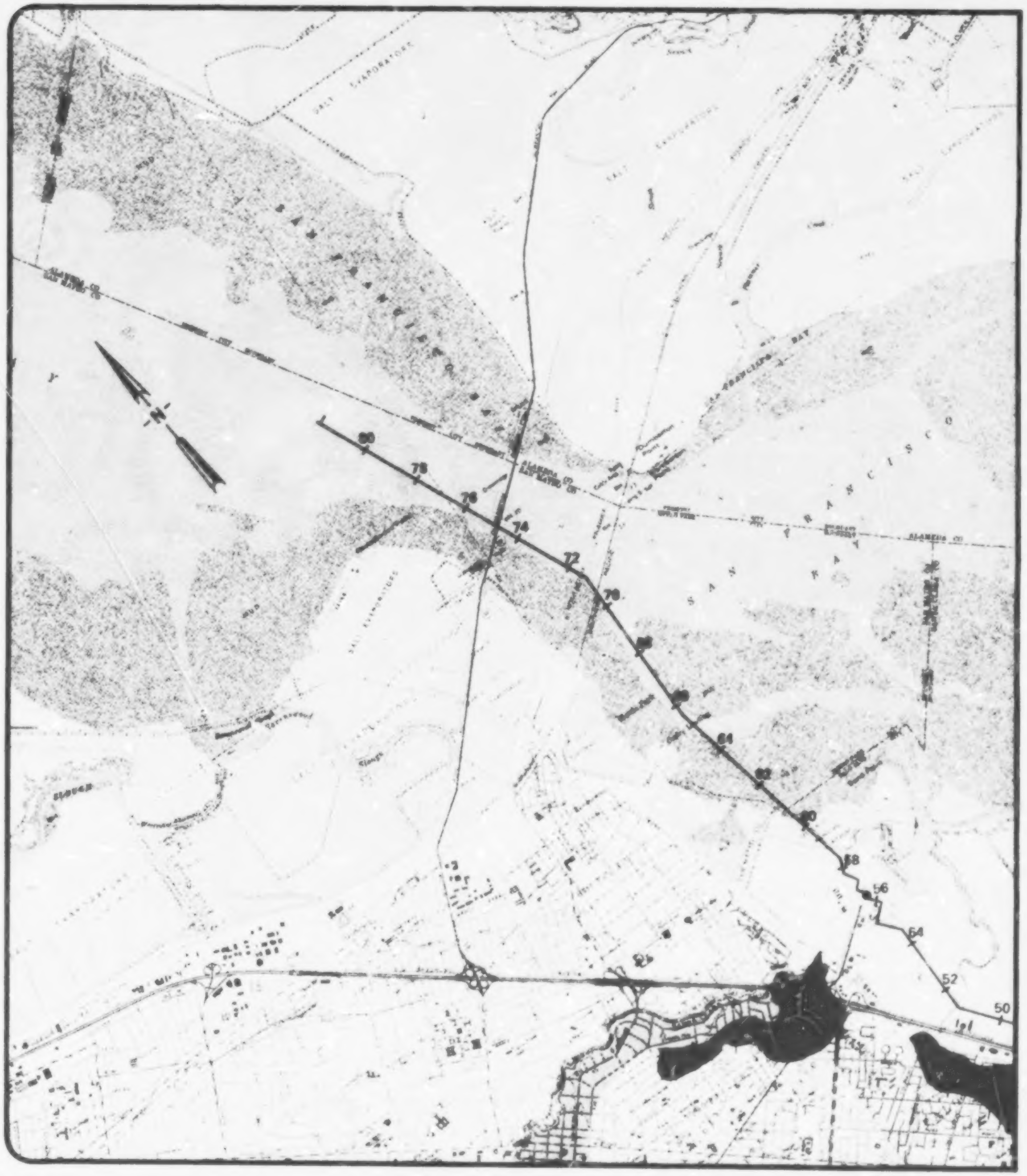
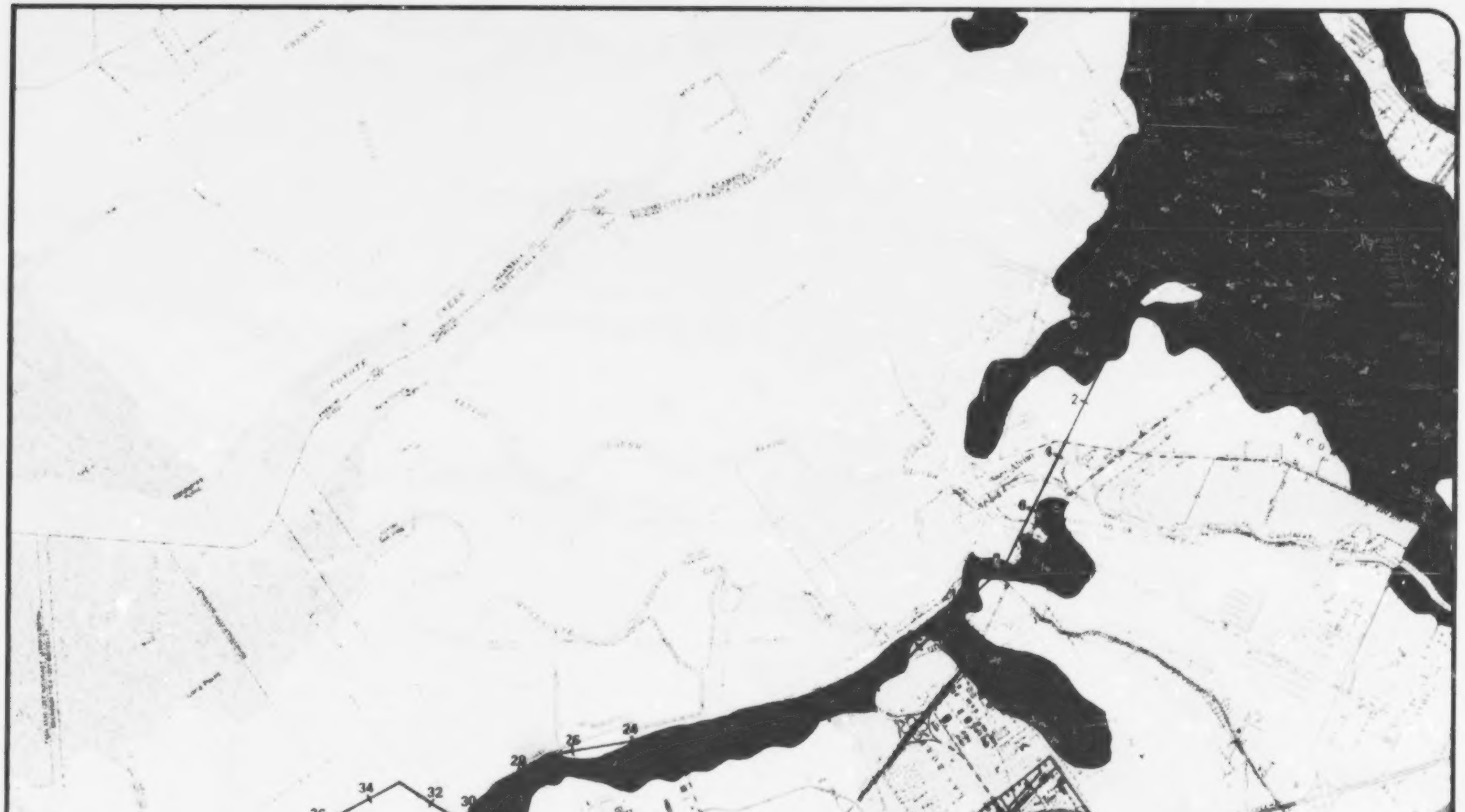

SAN FRANCISCO BAY
SAN FRANCISCO BAY
ALAMEDA CO
SAN MATEO CO
ALAMEDA CO
N
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
50

Figure II-21
ARCHAEOLOGICAL – PALEONTOLOGICAL DEPOSITS

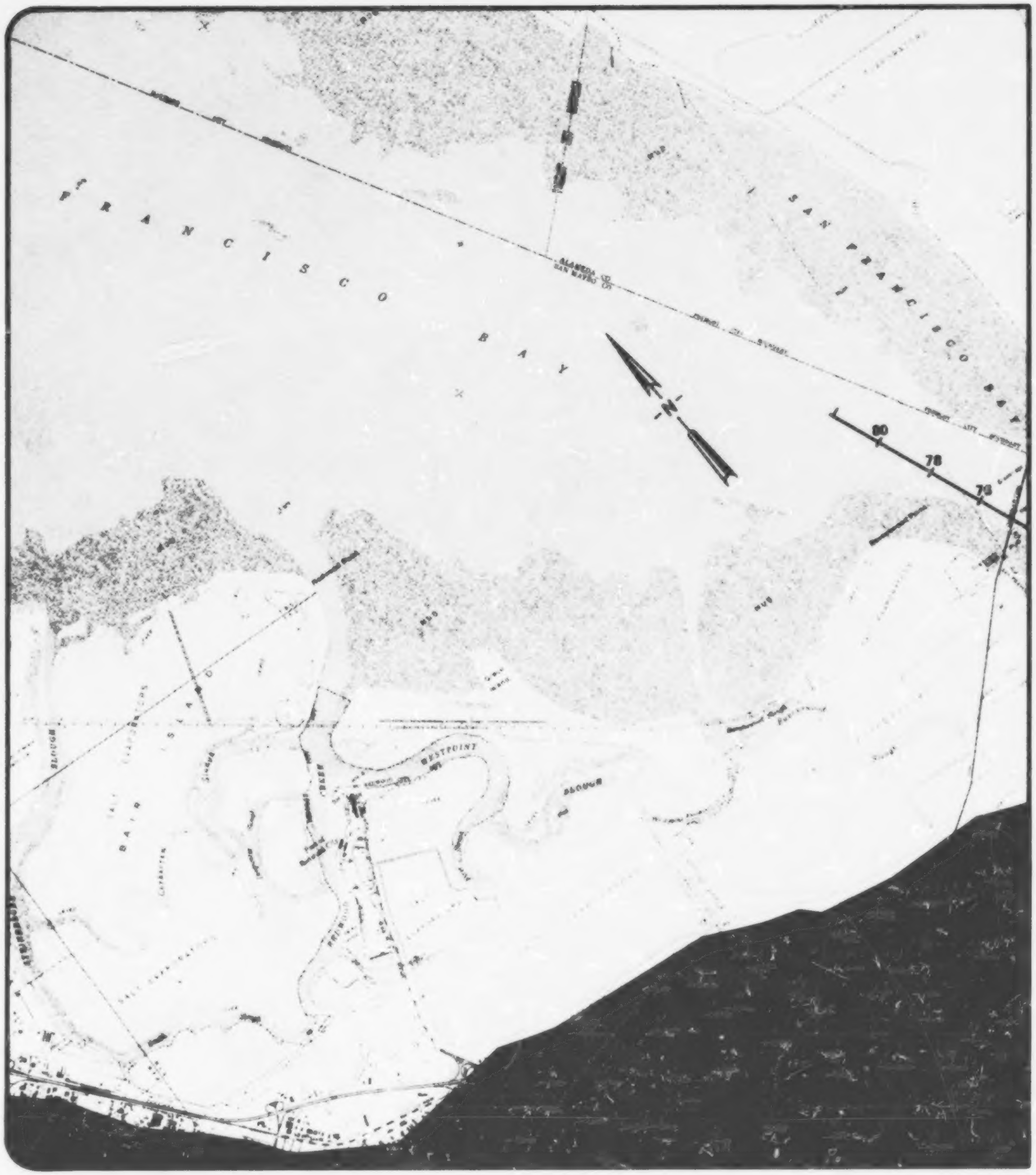

2
4
6
8
24
26
28
30
32
34
36
38
40
42
44
46
48
COYOTE CREEK
SUNNYVALE
SCALE IN MILES

LEGEND

■ Early Santa Clara Valley Ranchos

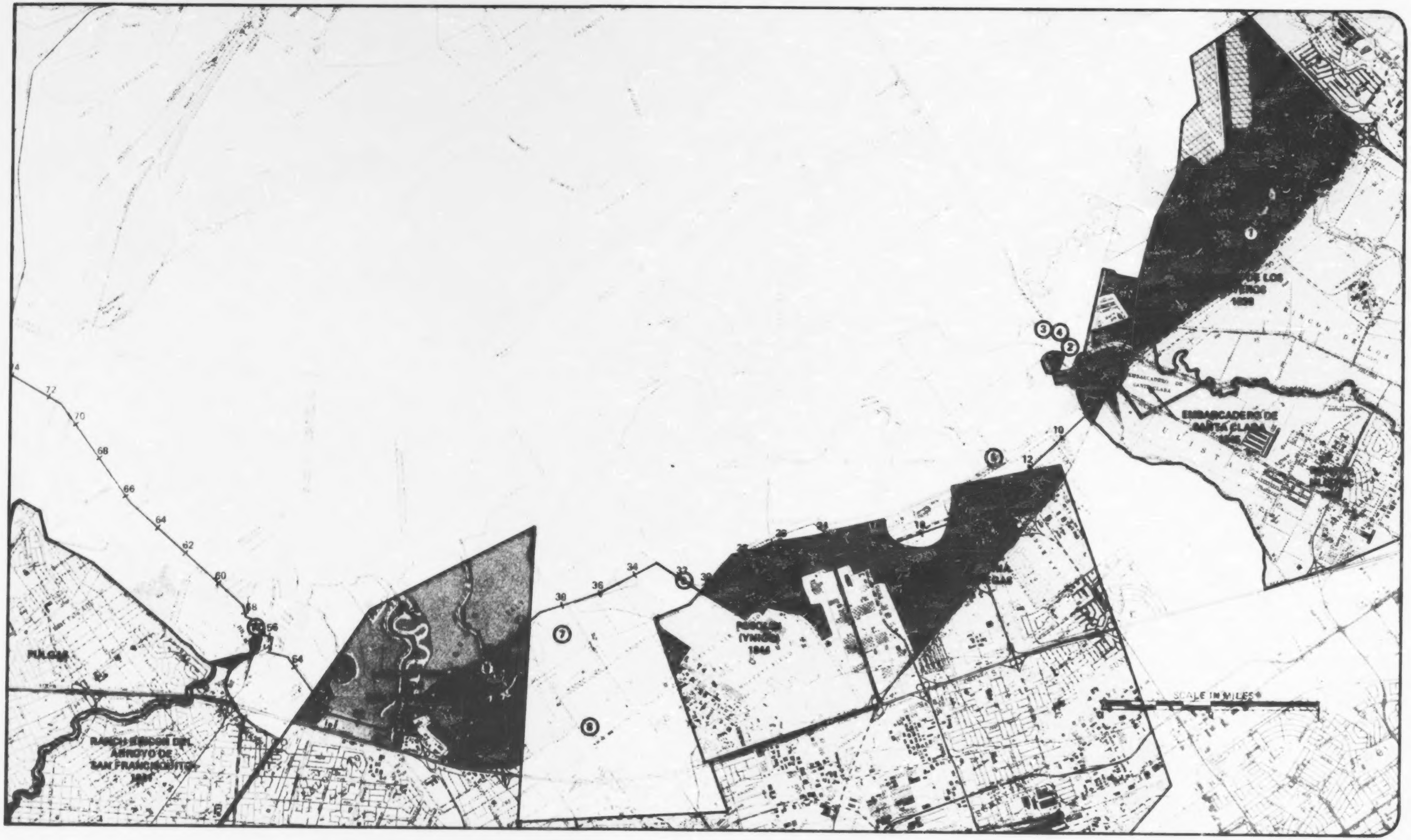
Historical Sites

1. Zanker House – 1860's
2. Freight Storage and Repair Station – late 1800's
3. D.K. Tilden House – 1860's
4. Alviso Depot – 1870's
5. McCubbins' Landing – 1897
6. Jagel's Landing – 1897
7. Guth's Landing – 1897
8. Rengstorff House – 1850's
9. Mountain View Landing – 1897
10. Clark's Landing – 1897
11. Wilson's Landing – 1897



SAN FRANCISCO BAY
SAN FRANCISCO BAY
ALAMEDA CO
SAN MATEO CO
N
80
78
76
WESTPOINT
SLOUGH
SLOUGH

Figure II-22
HISTORICAL SITES, LANDMARKS, AND RESIDENCES


①
③ ④ ②
DE LOS
1839
RINCON DE LOS
EMBARCADERO DE SANTA CLARA
EMBARCADERO DE SANTA CLARA
ULISTAC
10
12
⑤
74
72
70
68
66
64
62
60
58
56
54
38
36
34
32
30
28
26
24
18
⑦
⑧
PULGAS
RANCH RINCON DEL ARROYO DE SAN FRANCISQUITO
(YNIGO)
1844
SCALE IN MILES

variety of plants and animals. Many of the marshes are inhabited by a variety of waterfowl and grasses providing partially secluded rural settings within a short distance of a large metropolitan area.

The lack of land-use restrictions and the demands of the population residing in the South Bay region have been detrimental to the natural state of the Baylands. Numerous sanitary landfills, garbage dumps, industrial waste dumps, and dilapidated structures are found within the area. In addition, agriculturally productive areas have given way to numerous residential and industrial developments.

Industrial noise, polluted sloughs, odors from oxidation ponds, and visually unpleasant sanitary landfills occur in the Baylands. However, city and county planning and development commissions are implementing comprehensive land-use programs that will control the development of the area in the public interest and for public use and preserve the remaining natural areas for future generations.

Economic Setting

The economy of Santa Clara County has grown from a diversified agricultural/manufacturing-based structure to a specialized commercial/electronics-based structure. In 1950, agriculture and manufacturing employment accounted for 14.7 and 19.4 percent, respectively, of total county employment. By 1974, the economic composition of the county had changed to about 1.3 percent agricultural employment and 30 percent manufacturing employees in 1974, 102,800 were employed in aeronautics, electronic, and machinery manufacturing industries.

Table II-17 shows the growth of employment in Santa Clara County. Not only did employment in manufacturing grow at high rates, but employment in various levels of government also grew swiftly during the 1950-1974 period. Service, finance, insurance, and real estate employment also gained. However, food processing, within the nondurable manufactured goods category, for many years a major factor in the economy of the county, did not increase. This was due particularly to the conversion of agricultural land to other uses with concomitant reduction in supplies of fruits and vegetables.

In spite of the marked decrease in the number of farms and land under cultivation due to urban growth in Santa Clara County, San Jose and Sunnyvale remain important food processing centers. In 1974, there were 161 food and kindred product processing establishments, the largest of which were California Canners and Growers, Del Monte, and NCC Foods in San Jose, and Libby, McNeil, Libby in Sunnyvale. The fruit and vegetable canning and preserving industry employed an estimated 9,400 people in 1974.

Employment projections have been developed by the State Water Quality Control Board in conjunction with the State Department of Finance for selected industries through the year 2000. These projections are shown in Table II-18.

Continued economic growth in Santa Clara County suggests a continued increase in nonagriculturally-related employment. The rapid growth in the past was associated with an unusual upsurge in manufacturing activities in the county. Estimates of future employment show employment growth leading population growth, rising from 400 employed per 1,000 population in 1975 to 431 per 1,000 in the year 2000. It is believed that employment opportunities in the county will be the main force for population growth in the future. However, more of the employment will be in locally-oriented activities, such as trade and service, and in the production of light industrial and fabricated metal products.

The assessed valuation of the SBDA service area has grown dramatically over the past 11 years, reflecting a combination of growth in population and housing units and increases in property values resulting from supply/demand relationships and inflation.

Table II-17

NUMBER OF EMPLOYEES, SANTA CLARA COUNTY
1950-1974
(Employment in Thousands)

Employment Area	1950	1955	1960	1965	1970	1974(1)
Total Civilian Labor Force	124.0	153.7	242.4	336.7	448.9	564.0
Total Civilian Employment	109.9	144.6	228.0	316.5	423.7	531.0
Agriculture	16.2	15.6	11.2	8.4	6.7	6.1
Manufacturing	21.3	32.9	69.0	88.2	123.5	158.9
Durable Goods	8.6	17.0	50.9	67.4	98.0	132.6
Nondurable Goods	12.7	16.0	18.1	20.8	25.5	26.3
Food and Kindred Products	10.7	12.2	12.5	13.1	14.1	14.4
Fruit and Vegetable Canning and Preserving	9.2	9.8	9.1	8.8	8.8	9.4
Other Food and Kindred Products	1.5	2.4	3.4	4.3	5.3	5.0
Mining	0.1	0.1	0.1	0.2	0.1	0.1
Construction(2)	7.7	11.5	15.3	17.4	17.6	19.9
Transportation, Communication, and Utilities	5.8	7.4	9.2	12.3	17.0	19.0
Trade	17.5	22.9	34.5	49.4	71.0	88.8
Wholesale	2.7	3.7	5.6	9.4	14.9	19.3
Retail	14.8	19.2	28.9	40.0	56.1	69.5
Finance, Insurance, Real Estate	2.4	3.7	6.4	9.8	13.1	17.9
Services	11.5	15.6	30.5	53.9	75.5	94.0
Government	11.7	16.1	26.8	43.4	60.0	71.0
Federal	3.8	3.6	5.2	7.7	9.5	9.4
State and Local	7.9	12.4	21.6	35.7	50.5	61.6
City	1.6	1.9	3.5	5.3	6.9	8.5
County	1.3	1.8	3.0	5.2	7.6	10.0
Other State and Local(3)	5.0	8.6	15.1	25.2	36.0	43.1
Other Nonagricultural(4)	15.7	18.7	25.0	33.5	39.2	-
Total Unemployment	14.1	9.1	14.4	20.2	25.2	33.0
Unemployment Rate%	11.3	5.9	5.9	6.0	5.6	5.9

Notes:
(1) Estimated.
(2) Does not include force account and government construction workers.
(3) Includes employees of state, public schools, and special districts.
(4) Includes employers, own-account workers, unpaid family workers, and domestics.
Source: Santa Clara County Planning Department, Part B, 1949-1965, 1956-1974; State Department of Industrial Relations, 1966-1971.

The total assessed valuation of property in the SBDA and tributary agency areas has increased from $1.54 billion in 1963/64 to $3.55 billion in 1973/74. This represents an overall increase of 131 percent, the equivalent of an annual compound growth rate of 9 percent. Valuation changes of individual districts within the area have varied considerably over the past 11 years, and in general, the valuations of the northern sections

Table II-18

EMPLOYMENT PROJECTIONS FOR SELECTED INDUSTRIES IN SANTA CLARA COUNTY(1)
1975-2000
(Employment in Thousands)
(SWRCB and RWQCB, 1974)

Industry	1975	1980	1990	2000	% of Change 1975-2000
Commercial	379.7	336.9	376.4	448.5	40.3
Light industrial	108.5	120.9	142.0	169.4	56.1
Food (SIC 20)	13.1	12.8	12.4	11.9	-9.2
Paper (SIC 26)	2.6	2.6	2.5	2.5	-3.8
Chemicals (SIC 28)	1.3	1.4	1.5	1.7	30.8
Petroleum (SIC 29)	0.1	0.1	0.1	0.1	0
Primary Metals (SIC 33)	0	0	0.1	0.1	-
Metal Fabrication (SIC 34)	10.9	12.4	16.9	20.9	91.7
Total	453.6	486.8	551.8	655.0	44.4

Note:
(1) That portion of Santa Clara County in Basin 2 hydrographic unit as defined by SWRCB.

of the area grew less rapidly than did the southern sections.

Assessed valuation is the basis of the property tax levy that remains the cornerstone of local revenues. However, while this base has increased substantially, the property tax has diminished in importance as a source of revenue to the communities in the area. This is particularly true in the financing of sewage conveyance and treatment operations, where there has been a shift from property tax to user charges as a source of financing. The trend away from property taxes toward other revenue sources has been given support in recent years by legislation to limit tax rates where such limits did not already exist.

II.2

LAND USE

II.2.1 PRESENT LAND-USE PATTERNS

Santa Clara and San Mateo Counties have exhibited major land-use changes over the past two and one-half decades. Over this period, the use of agricultural land has shifted to a variety of other urban and industrial uses. In this section, the present land-use patterns are described, with an emphasis on existing private and public developments or facilities located in or near the Baylands of these counties.

Existing Land Use

Santa Clara County. A comprehensive inventory, prepared by the Santa Clara County Planning Department (1967, 1972) is the most recent land-use study of the county. In 1967, Santa Clara County had a total land area of 847,000 acres, of which about 752,300 acres, or 90 percent, were subject to taxation. The 1967 inventory was based on a population of 960,000, as compared to a current 1975 population of 1,193,400, a 24-percent increase. This implies an increase in urban land-use development. A summary of 1975 land-use patterns for Santa Clara County is presented in Figure II-23.

Land-use inventory data, from the 1967 study, is presented in Table II-19. Over 85 percent of the assessed land in the county was in either agricultural use or in some other use considered not to be developed. The remaining 15 percent was devoted to residential, commercial, industrial, public, transportation, or vacant urban land use.

Before its intensive urbanization, the Santa Clara Valley was an important agricultural region. Its mild, ocean-modified climate, the long growing season, its rich, deep alluvial soils, abundant water, and nearby markets all combined to make the valley a highly productive agricultural area. It was ideal for intensive irrigated production of fruits, vegetables, and other specialty crops.

Table II-19

LAND-USE PATTERNS IN THE BAYLANDS
OF SANTA CLARA COUNTY COMPARED WITH
COUNTYWIDE LAND USE, 1967

(Santa Clara County Planning Department, 1972)

	Assessed Land Santa Clara	Land in Study Area	
Land Use	Total Acres (%)	Total Acres (%)	Study Area/ County Area (%)
Residential	48,200 (6.4)	430 (2.1)	0.9
Industrial	6,300 (0.8)	860 (4.5)	8.2
Transportation, Utilities	1,400 (0.2)	430 (2.2)	30.5
Commercial	4,300 (0.6)	70 (0.4)	1.6
Public	7,100 (0.9)	200 (1.0)	2.8
Urban, Vacant	15,700 (2.1)	960 (4.9)	6.1
Agricultural	542,800 (72.2)	3,250 (16.4)	0.6
Other	126,500 (16.8)	-	10.7
Open Space		-	
Marsh		1,920 (9.7)	
Salt Ponds		9,910 (50.0)	
Bay Water		1,760 (8.9)	
Total	752,300 (100.0)	19,800 (100.0)	2.6

LEGEND

- ▭ – Residential
- ■ – Commercial – Industrial
- ■ – Agricultural
- ■ – Government Facilities, Schools
- ■ – Recreation, Open Space, Salt Evaporators, Marshlands.

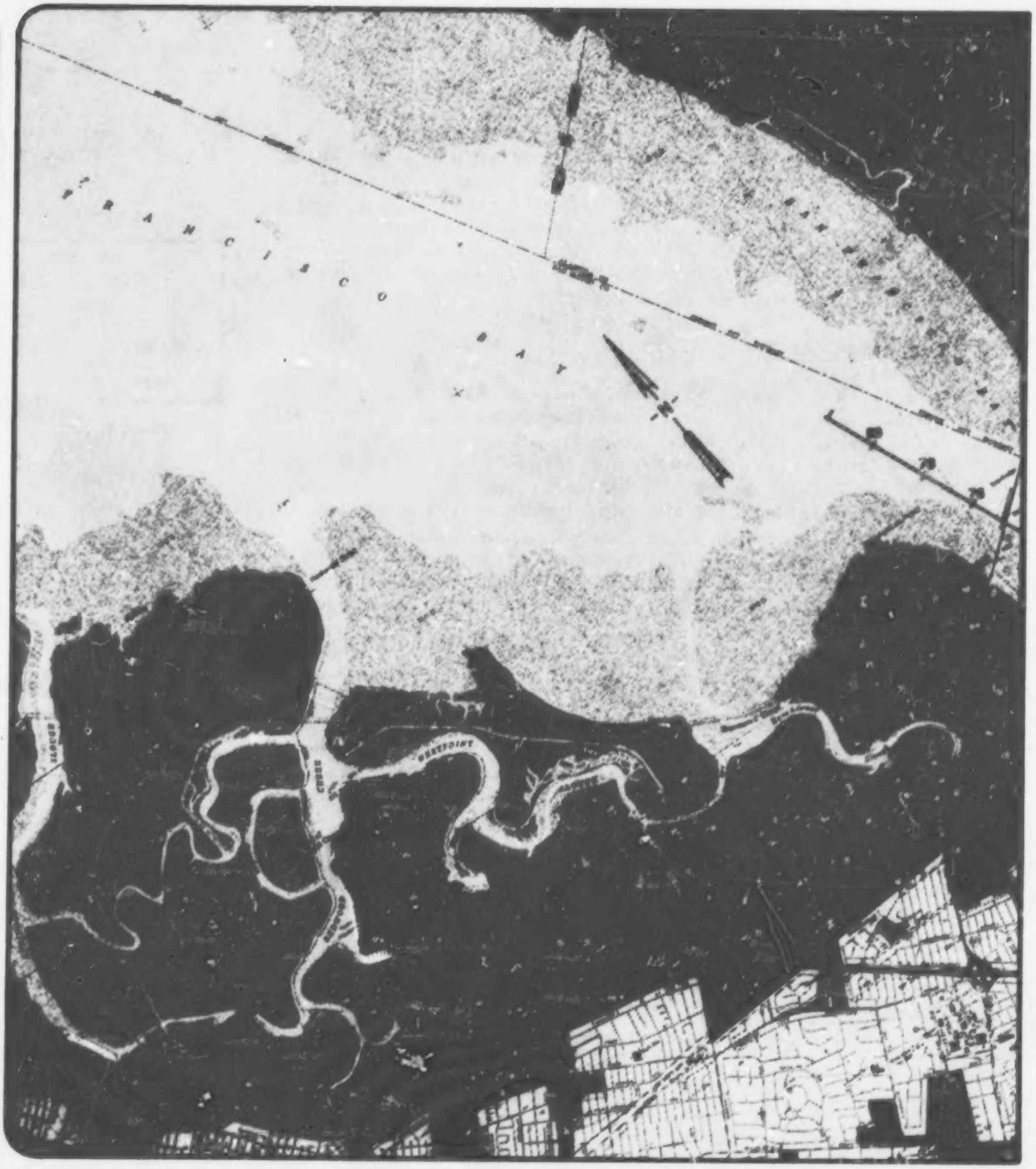

FRANCISCO BAY
SLOUGH
CREEK
WESTPOINT
REDWOOD

Figure II-23
1975 LAND USE

San Francisco Bay
CREEK
72
70
68
66
64
62
60
58
54
50
44
42
40
38
36
32
30
28
2

In the Baylands of Santa Clara County some agricultural land use continues. However, these lands are zoned for a variety of uses (industrial, residential, open space) and provide only average yields per acre in relation to other agricultural lands in the county. For crops currently under cultivation in the Baylands, Table II-20 summarizes average yields, growing seasons, and estimates of production values.

In 1967, almost 80 percent of the lands in the county classified as industrial were in seven cities located around the southern tip of San Francisco Bay. San Jose alone accounted for almost 30 percent of the industrial land in the county.

The Baylands include less than one percent of the residential land in the county, the majority of which is located in and around Alviso. However, 30 percent of all land dedicated to transportation and 8.3 percent of all industrial land in the county is located in the Baylands.

San Mateo County. The San Mateo County land-use inventory is based on the County Planning Commission's *1970 Existing Land Use in Acres* (1972). The 1972 data were based on an update of the 2,000-foot-scale 1960 Generalized Land-Use Map and 1970 aerial photographs. San Mateo County has 287,055 "land" acres, with an additional 12,500 acres of bay water.

The 1972 study revealed that the county had 206,120 acres of vacant land and 80,935 acres of developed land. The vacant land accounts for 71.8 percent of the total land area. Residential land occupies 46,220 acres or approximately 57 percent of the developed land. The majority of industrial, transportation, and commercial land use is located along the San Francisco Bay shoreline, as in Santa Clara County, and accounts for 14 percent of the developed lands. Table II-21 presents areas and percentages of land uses in the county.

Existing Public and Private Developments

The Basin Plan Alternative alignment passes through or near numerous public and private developments in the Baylands of Santa Clara County (Figure II-24). A detailed discussion of the existing developments along the alignment from the San Jose/Santa Clara water pollution control plant to the disposal point is presented in the following paragraphs.

Table II-20

AGRICULTURAL PRODUCTIVITY
IN SANTA CLARA COUNTY BAYLANDS
(Santa Clara County Department
of Agriculture, 1975 and 1976)

Crop	Average Yield per Acre (tons)	Value per ton ($)	Gross Value ($/acre)	Production Costs ($/acre)
Processing Tomatoes March 1-Oct. 15	17.5	47	823	850-1,100
Onions (dry) Feb. 1-Sept. 15	18.5	95	715	800-1,000
Bell Peppers March 15-Nov. 1	9.5	170	1,615	800-900
Broccoli July 15-May 15	2	250	500	600-850
Sugar Beets Dec. 1-Nov. 1	38	20	760	600-800
Barley Nov. 1-July 1	0.6	96	56	50-60

Table II-21

LAND-USE PATTERNS IN THE BAYLANDS OF SAN MATEO COUNTY COMPARED WITH COUNTYWIDE LAND USE, 1972
(San Mateo County, 1972)

	Assessed Land San Mateo	Land in Study Area[1]	
Land Use	Total Acres (%)	Total Acres (%)	Study Area/ County Area (%)
Residential	46,220 (15.4)	2,215 (9.1)	4.8
Industrial	3,750 (1.3)	715 (2.8)	19.0
Transportation, Utilities	3,645 (1.2)	230 (0.9)	6.3
Commercial	3,220 (1.1)	140 (0.5)	4.3
Public	18,730 (6.2)	405 (1.6)	2.2
Urban, Vacant Agricultural	206,120 (68.7)	7,695 (31.4)	3.7
Other			
Open Space	-	-	-
Marsh[2]	295 (0.1)	295 (1.2)	100.0
Salt Ponds[2]	5,370 (1.8)	5,370 (21.9)	100.0
Bay Water[2]	12,500 (4.2)	7,463 (30.6)	59.7
Total	299,850 (100.0)	24,527 (100.0)	8.2

Notes:

(1) Land east of Bayshore Freeway, north of Santa Clara County line, south of San Mateo Bridge.

(2) Basic data obtained by planimetering updated 1960 General Land-Use Map, scale 2,000 feet.

Only a small portion of the Baylands is not incorporated into one of six municipalities of Santa Clara County. Unincorporated areas consist of the salt ponds and open water north of Mountain View, Moffett Field, and miscellaneous parcels in the upland areas inside the city limits of Mountain View, Santa Clara, San Jose, and Milpitas (Santa Clara County Planning Department, 1972). Unincorporated areas within the sphere of influence of (and adjacent to) cities are ultimately to be incorporated into those cities.

The City of San Jose occupies the largest portion of the Baylands in Santa Clara County, subsequent to the consolidation of Alviso. The salt ponds, marshes, and sloughs, from Guadalupe Slough on the west to Coyote Creek on the east, fall within the current city boundary (Santa Clara County Planning Department, 1972). The San Jose/Santa Clara water pollution control plant is located east of Alviso and north of Highway 237.

Northeast of Alviso is the New Chicago Marsh, a diked area adjacent to the salt ponds, which receives tidal circulation at only a few places. The New Chicago Marsh has been subdivided for many years and is in mixed public and small private ownership, although less than half of the originally planned subdivision is developed (Sunnyvale City Council, 1963; City of San Jose, 1966). The entire area is zoned for residential development. Owens-Corning Fiberglass Company is currently using a small parcel west of the San Jose treatment plant and north of Zanker Road for disposal of its industrial wastes.

The Baylands portion of the City of Santa Clara follows Route 237 between Calabazas Creek and the Guadalupe River. Agricultural uses are continuing here, although industries are beginning to locate in this area. A municipal refuse dump is located off Lafayette Street and the Santa Clara-Alviso Road. Present zoning is mixed between public facilities and agricultural classifications. Landfill has been used in a few developed areas near Route 237 that are subject to saltwater flooding or freshwater inundation.

LEGEND

㉔ EXISTING FACILITIES

▬ Leslie Salt Company
Salt Evaporator Designation

1. San Jose/Santa Clara Sewage Disposal Treatment Plant
2. New Chicago Marsh
3. Sunnyvale Sewage Disposal Treatment Plant
4. Lockheed Aircraft Plant
5. Moffett Field, Naval Air Station
6. Ames Research Center (NASA)
7. Mountain View Shoreline Park
8. Charleston Slough
9. Palo Alto Baylands Reserve
10. ITT Radio Facility
11. Palo Alto Sewage Disposal Treatment Plant
12. Palo Alto Yacht Harbor
13. Palo Alto Municipal Airport
14. Palo Alto Municipal Golf Course
15. Farber Tract
16. Laumeister Tract
17. Cooley Landing
18. Hetch Hetchy Aqueduct
19. Dumbarton Bridge
20. Greco Island
21. Bair Island

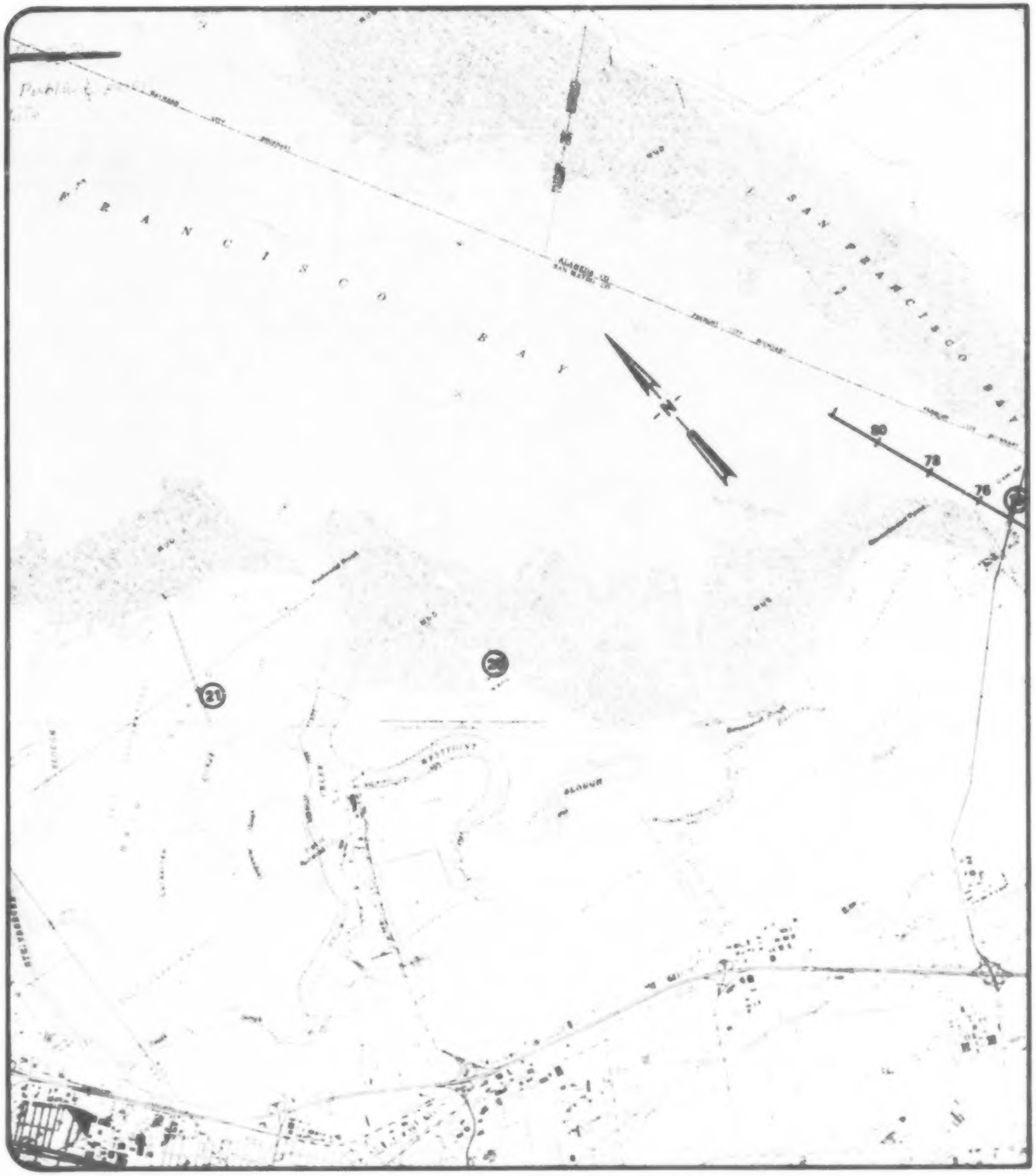
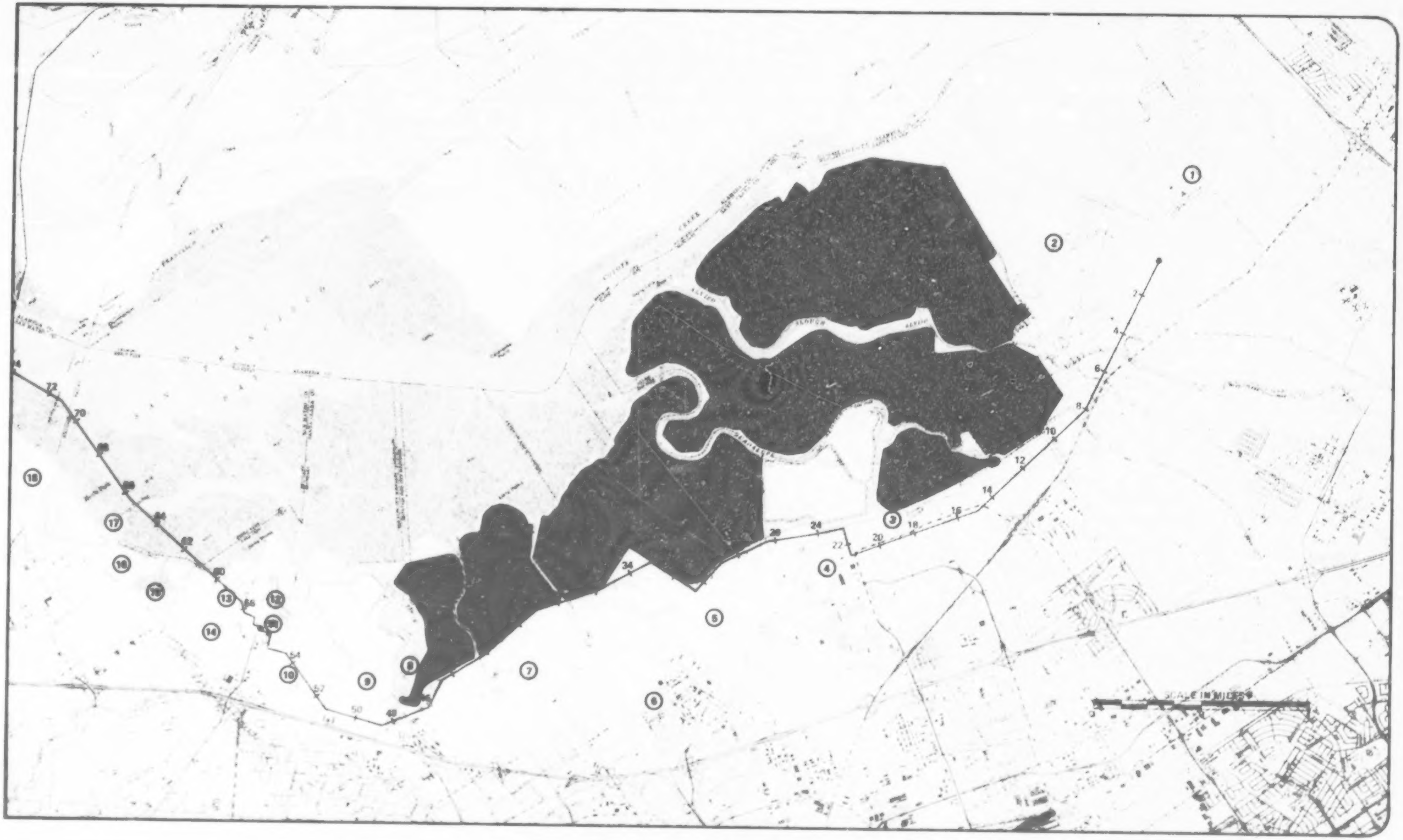


Figure II-24
EXISTING PUBLIC AND PRIVATE FACILITIES


①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑬
⑭
⑯
⑰
⑱
2
4
6
8
10
12
14
16
18
20
22
24
34
50
57
64
66
70
72
SLOUGH
ALAMEDA
SCALE IN MILES
0

CONTENTS

Section Page

I DESCRIPTION OF BASIN PLAN AND ALTERNATIVES

I.1 DESCRIPTION OF ALTERNATIVES 1 1/D13
  I.1.1 Introduction 1 1/D13
  I.1.2 Background and Objectives 4 1/E5
  I.1.3 Criteria for Evaluation of Alternatives 6 1/E9
  I.1.4 Evaluation of Alternatives 6 1/E9
    Alternative 2 — No Further Action 9 1/F1
    Alternative 3 — Individual Outfalls to Nearest Deepwater 10 1/F3
    Alternative 4 — Local Discharge with Upgraded Treatment 11 1/F5
    Alternative 5 — Reclamation and Reuse of Treated Wastewater 13 1/F9
  I.1.5 Alternative Alignments to Basin Plan Alternative 15 1/F13
I.2 THE BASIN PLAN ALTERNATIVE 19 1/G7
  I.2.1 Location 19 1/G7
  I.2.2 Facilities for the Basin Plan Alternative 21 1/G11
    San Jose/Santa Clara Pumping Station 22 1/G13
    Pipeline Segment — San Jose Santa Clara to Sunnyvale 22 1/G13
    Sunnyvale Pumping Station 22 1/G13
    Pipeline Segment — Sunnyvale to Palo Alto 24 2/B1
    Palo Alto Pumping Station 24 2/B1
    Pipeline Segment — Palo Alto to Discharge Point 24 2/B1
    Diffuser 24 2/B1
  I.2.3 Construction of the Basin Plan Alternative 25 2/B3
    Construction Procedures on Land 25 2/B3
    Construction Procedures in Water 26 2/B5
  I.2.4 Operation of the Basin Plan Alternative 28 2/B9
I.3 APPROVALS REQUIRED 29 2/B11

II ENVIRONMENTAL DESCRIPTION

II.1 PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT) 31 2/C3
  II.1.1 Physical Environment 31 2/C3
    Topography 31 2/C3
    Geology and Seismology 33 2/C7
    Groundwater 33 2/C7
    Soils 36 2/C13
    Sediments 37 2/D1
    Meteorology 39 2/D5
    Air Quality 40 2/D7
      — The Air Pollution Problem in the Bay Area 40 2/D7
      — Emissions and Air Quality 40 2/D7
      — Air Quality in the Bay Area 45 2/E3
      — Air Impacts of Wastewater Disposal 45 2/E3
    Hydrology 45 2/E3
      — Tides and Currents 46 2/E5
      — Circulation and Dispersion 47 2/E7
    Water Quality 49 2/E11
      — Temperature 51 2/F1
      — Transparency 51 2/F1
      — pH 51 2/F1
      — Suspended Solids 51 2/F1
      — Salinity 52 2/F3
      — Dissolved Oxygen and Oxygen Demand 53 2/F5
      — Nutrients 53 2/F5
      — Chlorophyll 54 2/F7
      — Coliform Bacteria 54 2/F7
      — Oil and Grease 55 2/F9
      — Toxicity 55 2/F9
      — Heavy Metals 57 2/F13
    Noise 57 2/F13
  II.1.2 Biological Environment 58 2/G1
    South Bay Habitats 58 2/G1
      — Open Water 61 2/G7
      — Tidal Mud Flats 64 2/G13
      — Salt Marsh 68 3/B5
      — Salt Ponds 71 3/B11
      Dikes and Levees 74 3/C3
      — Grasslands 75 3/C5
      — Streams and Sloughs 75 3/C5
      — Freshwater Marshes and Ponds 77 3/C9
    Species of Special Concern 78 3/C11

II.1.3 Social, Economic, and Cultural Environment 83 3/D7
  Population and Demography 83 3/D7
  Recreational and Scientific Uses of the Area 87 3/E1
  Archaeological, Paleontological, Historical and Cultural Resources 88 3/E3
    — Archaeological Resources 88 3/E3
    — Paleontological Resources 89 3/E5
    — Historical and Cultural Resources 89 3/E5
  Visual and Aesthetic Setting 93 3/E13
  Economic Setting 98 3/F9

II.2 LAND USE

II.2.1 Present Land-Use Patterns 101 3/G1
  Existing Land Use 101 3/G1
    — Santa Clara County 101 3/G1
    — San Mateo County 104 3/G7
  Existing Public and Private Developments 104 3/G7
  Mineral Resources of the Baylands 112 4/B7
II.2.2 Projected Land-Use Patterns 112 4/B7
  Planned Public and Private Developments 112 4/B7
  Land-Use Plans and Planning Agencies 114 4/B11
  Interested Agencies 118 4/C5
    — Local 118 4/C5
    — Regional 118 4/C5
    — State 118 4/C5
    — Federal 119 4/C7

II.3 WATER USE

II.3.1 Existing and Proposed Wastewater Treatment Facilities 120 4/C9
  San Jose/Santa Clara Regional Water Pollution Control Plant 120 4/C9
  Sunnyvale Water Pollution Control Plant 120 4/C9
  Palo Alto Treatment Plant 121 4/C11
  Menlo Park Sanitary District Wastewater Treatment Plant 121 4/C11
  Redwood City Sanitary District — Redwood City Sewage Treatment Facility 121 4/C11
  Redwood City Sanitary District — Redwood Shores Plant 122 4/C13
  Belmont/San Carlos Joint Sewage Treatment Facility 122 4/C13
  Proposed Redwood Shores Subregional Plant 122 4/C13
  Union Sanitary District — Alvarado, Plant No. 3 122 4/C13
  Union Sanitary District — Newark, Plant No. 1 122 4/C13
  Union Sanitary District — Irvington, Plant No. 2 122 4/C13
II.3.2 Current and Projected Sources of Water 122 4/C13
II.3.3 Current Water Use and Projected Demand 123 4/D1
II.3.4 Current and Projected Water Quality 123 4/D1

III ENVIRONMENTAL IMPACTS

III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129 4/E1
III.1.1 Construction Impacts 129 4/E1
  Physical Environment 129 4/E1
    — Topography 129 4/E1
    — Air Quality 130 4/E3
    — Water Quality 131 4/E5
    — Sediment Quality 132 4/E7
    — Noise 132 4/E7
  Biological Environment 133 4/E9
    — Segment I — San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134 4/E11
    — Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant 136 4/F1
    — Segment III — Palo Alto Treatment Plant to Discharge Point 138 4/F5
  Social, Economic, and Cultural Environment 140 4/F9
    — Recreational Uses of the Area 140 4/F9

— Archaeological, Paleontological, and Historical Resources 141 4/F11
— Visual and Aesthetic Setting 141 4/F11
— Economic Setting 141 4/F11
— Present Land-Use Patterns 143 4/G1
— Projected Land-Use Patterns 144 4/G3
III.1.2 Operation Impacts 144 4/G3
Physical Environment 144 4/G3
— Hydrology 144 4/G3
— Water Quality 144 4/G3
— Sediment Quality 148 4/G11
— Noise 150 5/A13
Biological Environment 152 5/B3
Social, Economic, and Cultural Environment 154 5/B7
— Recreational Uses of the Area 154 5/B7
— Visual and Aesthetic Setting 155 5/B9
— Present and Future Land-Use 155 5/B9
— Energy Consumption 155 5/B9
III.1.3 Economic Impact of the Basin Plan Alternative 155 5/B9
Introduction 155 5/B9
Study Assumptions and Methodology 155 5/B9
— Capital Costs 156 5/B11
— Operation and Maintenance Costs 158 5/C1
Computation of Allocation Factors 158 5/C1
User Charges to Discharger Groups 159 5/C3
— Residential Dischargers 159 5/C3
— Commercial Dischargers 159 5/C3
— Industrial Dischargers 159 5/C3
— Direct Impact on Industrial Dischargers 162 5/C9
Analysis of the Canned Fruit and Vegetable Industry 163 5/C11
— Industry Characteristics 163 5/C11
— Methodology 164 5/C13
— Conclusions of Analysis 165 5/D1
Conclusions 165 5/D1
III.1.4 Accident or Natural Catastrophe 166 5/D3
Flooding 166 5/D3
Earthquake 166 5/D3
Plant Upset 166 5/D3
Pumping Station Malfunction 166 5/D3
III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168 5/D7
III.2.1 Adverse Construction Effects 168 5/D7
Physical Environment 168 5/D7
Biological Environment 168 5/D7
Social, Economic, and Cultural Environment 168 5/D7
III.2.2 Adverse Operational Effects 169 5/D9
Physical Environment 169 5/D9
Biological Environment 169 5/D9
Social, Economic, and Cultural Environment 169 5/D9
III.3 MITIGATION MEASURES 170 5/D11
III.3.1 Mitigation of Construction Impacts 170 5/D11
Proposed Measures 170 5/D11
Potential Measures 172 5/E2
III.3.2 Mitigation of Operation Impacts 173 5/E3
Proposed Measures 173 5/E3
Potential Measures 173 5/E3
III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174 5/E5
III.4.1 Short-Term Uses of Man's Environment 174 5/E5
III.4.2 Maintenance and Enhancement of Long-Term Productivity 174 5/E5
III.4.3 Need for the Project 175 5/E7
III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176 5/E9
III.5.1 Permanent Changes in Land Features and Land Use 177 5/E11
III.5.2 Biological Systems 177 5/E11
III.5.3 Assimilative Capacity of the Bay 177 5/E11
III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177 5/E11
III.6 GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178 5/E13

IV ALTERNATIVES TO THE BASIN PLAN

IV.1 INTRODUCTION 181 5/F7
IV.2 ALTERNATIVES 182 5/F9

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183 5/F11
Participation by Other Entities 184 5/F13
Alternative Alignments 184 5/F13
Result of Screening 185 5/G1
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188 5/G7
Result of Screening 190 5/G11
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190 5/G11
Result of Screening 191 5/G13
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193 6/B1
Result of Screening 195 6/B5
IV.2.5 Alternative 5 — Reclamation and Reuse 195 6/B5
Reclamation in Santa Clara County 197 6/B9
Smaller Reuse Markets in the Service Area 199 6/B13
Markets Outside the Service Area 201 6/C3
Result of Screening 202 6/C5
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202 6/C5
Result of Screening 203 6/C7
IV.2.7 Alternative 7 - Discharge to the Ocean 203 6/C7
Result of Screening 204 6/C9
IV.2.8 Alternative 8 — Land Disposal 204 6/C9
Result of Screening 205 6/C11
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206 6/C13
Result of Screening 206 6/C13
V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION
V.1 INTRODUCTION 207 6/D3
V.2 STUDY AREA 209 6/D7
V.2.1 Location of Study Area 210 6/D9
V.2.2 Water Demand and Supply 210 6/D9
V.2.3 Quality of Groundwater Supplies 213 6/E1
V.2.4 Quality of Soils 213 6/E1
V.2.5 Agricultural Land Use 215 6/E5
V.3 CONCEPTUAL DESIGN 217 6/E9
V.3.1 Potential Markets 218 6/E11
V.3.2 Reclaimed Water Quality 219 6/E13
Source Control 221 6/F3
Level of Reclaimed Water Treatment 222 6/F5
V.3.3 Treatment Conceptual Designs 224 6/F9
Reclaimed Water Flow Diversion 226 6/F13
Coagulation and Sedimentation with Alkalinity Control 226 6/F13
Alkalinity Control 230 6/G7
Partial Desalination Treatment 232 6/G11
V.3.4 Conveyance and Distribution Conceptual Designs 233 6/G13
Pumping 234 7/A13
Conveyance Pipeline 235 7/B1
Santa Clara Valley Distribution System 236 7/B3
Bolsa Distribution System 236 7/B3
User Connections 236 7/B3
V.3.5 Cost Estimates 242 7/C1
Basis of Estimate 242 7/C1
Engineering Construction Management Contingency 244 7/C5
Escalation 244 7/C5
Schedule 244 7/C5
Operation and Maintenance 244 7/C5
Major Exclusions 244 7/C5
Assumptions 244 7/C5
V.3.6 Blending Alternatives 244 7/C5
Blended Water Quality 245 7/C7
Blended Water Markets 245 7/C7
Blended Water Distribution 246 7/C9
Blending System Alternatives 247 7/C11
V.3.7 Alternating Supply Alternatives 247 7/C11
V.3.8 Summary 248 7/C13
V.4 AGRICULTURAL IMPACTS 249 7/D1
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250 7/D3
Salinity Effects 251 7/D5
Effects of High Sodium Concentrations 253 7/D9

Specific Ion Toxicity 255 7/D13
Summary of Effects on Agriculture of Cases A and B 255 7/D13
V.4.2 Impact of Cases C, D, B_1, B_2, and B_3 in the Santa Clara County Portion of the Study Area 256 7/E1
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257 7/E3
V.5 ECONOMIC IMPACT ANALYSIS 259 7/E7
V.5.1 Conceptual Level Costs 259 7/E7
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260 7/E9
V.5.3 Economic Impact on Agriculture 260 7/E9
V.6 OTHER IMPACTS 263 7/F1
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264 7/F3
V.6.2 Long-Term Buildup of Salts in Soil 265 7/F5
V.6.3 Public Health Concerns 265 7/F5
V.6.4 Effects on Land Use and Water Use 266 7/F7
V.6.5 Energy Consumption 266 7/F7
V.6.6 Other Effects 267 7/F9

VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270 7/G3
VI.1.1 Disposal of Bittern 271 7/G5
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272 7/G7
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273 7/G9
VI.1.4 Other Disposal Alternatives 276 8/A13
Continued Storage 276 8/A13
On-Land Dilution 276 8/A13
VI.2 PRESENT ENVIRONMENT 277 8/B1
VI.2.1 Physical Environment 277 8/B1
Topography 277 8/B1
Soils 278 8/B3
Sediments 278 8/B3
Hydrology 278 8/B3
Water Quality 278 8/B3
— Temperature and Salinity 278 8/B3
— Chemical Characteristics 280 8/B7
VI.2.2 Biological Environment 280 8/B7
Open Water and Tidal Mud Flats 280 8/B7
Salt Marsh 280 8/B7
Salt Ponds 280 8/B7
Dikes and Levees 282 8/B11
Streams and Sloughs 282 8/B11
Species of Special Concern 283 8/B13
VI.2.3 Social and Cultural Environment 283 8/B13
Recreational Uses of the Area 283 8/B13
Archaeological, Paleontological, Historical, and Cultural Resources 284 8/C1
Visual and Aesthetic Setting 284 8/C1
Existing and Proposed Land Use 284 8/C1
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285 8/C3
VI.3.1 Discharging to Basin Plan Alternative 285 8/C3
Construction Impacts — Physical Environment 285 8/C3
— Topography 285 8/C3
— Air Quality 285 8/C3
— Water Quality 286 8/C5
— Sediment Quality 286 8/C5
— Noise 286 8/C5
Construction Impacts — Biological Environment 286 8/C5
— Salt Pond Dikes 286 8/C5
— Open Water 286 8/C5
Construction Impacts — Social, Economic, and Cultural Environment 287 8/C7
— Recreational Uses of the Area 287 8/C7
— Archaeological, Paleontological, and Historical Resources 287 8/C7
— Economic Setting 287 8/C7
— Present and Projected Land-Use Patterns 287 8/C7
Operational Impacts — Physical Environment 287 8/C7
— Water Quality 287 8/C7
— Sediment Quality 290 8/C13
— Noise 290 8/C13
Operational Impacts — Biological Environment 291 8/D1

Operational Impacts — Social, Economic, and Cultural Environment 292 8/D3
— Economic Setting 292 8/D3
VI.3.2 Discharging Through Separate Diffusers 292 8/D3
Construction Impacts — Physical Environment 292 8/D3
— Topography 292 8/D3
— Air Quality 292 8/D3
— Water Quality 292 8/D3
— Sediment Quality 292 8/D3
— Noise 292 8/D3
Construction Impacts — Biological Environment 293 8/D5
— Salt Pond Dikes 293 8/D5
— Open Water 293 8/D5
Construction Impacts — Social, Economic, and Cultural Environment 293 8/D5
— Recreational Uses of the Area 293 8/D5
— Visual and Aesthetic Setting 293 8/D5
— Economic Setting 293 8/D5
— Present and Projected Land-Use Pattern 294 8/D7
Operational Impacts — Physical Environment 294 8/D7
— Water Quality 294 8/D7
— Sediment Quality 295 8/D9
— Noise 295 8/D9
Operational Impacts - Biological Environment 296 8/D11
Operational Impacts — Social, Economic, and Cultural Environment 297 8/D13
— Economic Setting 297 8/D13
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298 8/E1
VI.4.1 Unavoidable Adverse Environmental Impacts 298 8/E1
VI.4.2 Mitigation Measures 298 8/E1
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299 8/E3
Short-Term Uses of Man's Environment 299 8/E3
Maintenance or Enhancement of Long-Term Productivity 299 8/E3
Need for the Project 299 8/E3
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302 8/E9
Permanent Changes in Land Features and Land Use 302 8/E9
Biological Systems 302 8/E9
Assimilative Capacity of the Bay 302 8/E9
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302 8/E9
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302 8/E9

VII SOURCES OF INFORMATION

VII.1 REFERENCES 305 8/F1
VII.1.1 Literature Cited in Text 305 8/F1
VII.1.2 Literature Cited in Figures 312 8/G1
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313 8/G3
VII.3 CONTACTS 316 8/G9
VII.4 DISTRIBUTION LIST 335 9/D3
VII.4.1 Federal Agencies 335 9/D3
VII.4.2 Libraries 338 9/D9
VII.4.3 Individuals and Private Groups 339 9/D11
VII.4.4 State Agencies 347 9/E13
VII.4.5 Regional Agencies and Local Government 348 9/F1
VII.4.6 Legislators 352 9/F9
VII.4.7 News Media 353 9/F11

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

Land use between the new Mountain View-Alviso Freeway (Route 237) and the salt ponds is changing from agricultural to industrial and is consistent with the general plan zoning classification for the area (Santa Clara County Planning Department, 1972; Corps of Engineers, 1973). On the west, the Lockheed Missiles and Space Company has intensively developed a sizable portion of its site. Adjacent to this is Moffett Industrial Park, where facilities for industrial tenants have been developed. About two-thirds of the industrial park is developed for industrial uses.

The City of Sunnyvale has a landfill in operation at the landward edge of the salt ponds near the treatment plant and Caribbean Road. Two former salt ponds near the Lockheed property are now owned by the city and used as oxidation ponds for sewage treatment.

Two federal government agencies own the unincorporated area between Mountain View and Sunnyvale: the Department of the Navy and the National Aeronautic and Space Agency (NASA) (Santa Clara County Planning Department, 1972). The Navy operates the Moffett Naval Air Station, which is dominated by a 9,200-foot runway and hangars. Personnel offices and quarters also occupy the southern part of the site. A golf course lies to the northeast, bordering the salt ponds. At the bayward end of the runway, which is susceptible to saltwater flooding, is a diked marsh, and beyond the marsh are salt ponds, located partly within the city limits of Sunnyvale and partly in an unincorporated area.

The NASA-Ames Research Center consists of over 20 wind tunnel facilities and related research equipment and offices. Most of the development is in the southern end of the site, and a new magnetism research facility occupies a northerly site location, near the diked marsh area off the Moffett runway. A large portion of the site adjacent to Stevens Creek is leased for agricultural use at present, but a wind tunnel, large enough to accommodate a full-size Boeing 747 is planned for sometime in the future. Within the Sunnyvale city limits is a large area of Leslie salt ponds toward the bayward side of Moffett Field and smaller holdings in the open water with ownership claimed by both the Ideal Cement Company and the state.

Moffett Channel, a drainage ditch running from the airfield to Guadalupe Slough, has been improved by Lockheed along the portion of the channel fronting on its property. The improvements include raised elevation of the south levee along Moffett Channel and the creation of a small pipeline from the retention basin parallel to the south levee discharging into Sunnyvale West Channel near its intersection with Moffett Channel.

The area adjacent to the Bayshore Freeway between Charleston Slough and Stevens Creek is in private urban use (Santa Clara County Planning Department, 1972). Agricultural uses with deteriorating semi-rural residences occupy the intermediate lands between the Bayshore Freeway and the salt ponds. The area bayward of Charleston Road is susceptible to saltwater flooding. The northern city limits bounds the 550-acre Mountain View Shoreline Park development.

The Mountain View Shoreline Park area, acquired jointly by Mountain View and Santa Clara County, is currently under development in a former marshland area. Refuse from San Francisco is being used to fill this area, utilizing the sanitary landfill technique. The plans include an 18-hole golf course, recreation center, amusement center, lakes, and open space meadow areas (City of Palo Alto, 1969). The scheduled completion date for the regional park landfill is in the late 1970's.

The Mountain View treatment plant occupied a site at the southernmost tip of Mountain View Slough. In the fall of 1972, this plant was converted to a pumping station to divert Mountain View sewage flows to the Palo Alto water pollution control plant. In Mountain View east of Charleston Slough, there are two salt ponds and a wet meadow. The salt ponds remain in the Shoreline Park Proposal (Santa Clara County Planning Department, 1972; California Business and Transportation Agency, 1973). This designation has been supported by the Planning Commission of the County of Santa Clara as possible sailing basins if salt production is discontinued (Santa Clara County Planning Department, 1972; Tudor Engineering, 1973).

Most of the Baylands in Palo Alto are owned by the city itself and consist of 3,900 acres between San Francisquito Creek and Charleston Slough. This acreage is susceptible to saltwater flooding.

The Santa Clara Valley Water District maintains a 600-acre flood retention basin between Mayfield Slough and Charleston Slough. This basin has become a wildlife area and is principally a dry grassland during most of the year. It is designated by the City of Palo Alto as the Palo Alto Wetland Preserve (Santa Clara County Planning Department, 1972). Its primary use is as a flood control facility, but its use as a wetland and wildlife habitat sanctuary is of major importance (Santa Clara County Planning Department, 1972). It is one of the few remnants of relatively undisturbed wetlands left in the Bay Area. Recreation uses here may include hiking, nature walks, and retriever dog training in limited areas. The present botanical community provides a permanent habitat and nesting area for several species of waterfowl, shorebirds, and mammals. It also provides wintering or resting grounds for many migratory waterfowl and shorebird species that complement the adjoining tidal marsh plant community.

Adjacent to and east of the Palo Alto Flood Retention Basin is Charleston Slough (Santa Clara County Planning Department, 1972). It is owned by Leslie Salt Company and provides an intake for the solar evaporation system by which salt is extracted from the Bay. It consists of approximately 190 acres and is a valuable wildlife habitat area that is not open to the public, but is leased to a private duck hunting and fishing club.

All of the marshes and adjoining tidal flats in Palo Alto have now been designated as a Marshland Preserve (Santa Clara County Planning Department, 1972). These include the marshes at the mouth of Charleston Slough, and the Sand Point, Hook Island, Palo Alto Yacht Harbor, and Castle Island marshes.

North of the Flood Retention Basin is the Palo Alto Yacht Harbor and the Palo Alto Airport. The northwest area occupied by the airport and yacht harbor is leased to Santa Clara County, which built and now maintains these facilities. The Palo Alto Airport is adjacent to the Palo Alto Municipal Golf Course and is a major general aviation facility. Adjacent to the airport are unoccupied clear zones at the end of the runway.

Contiguous to the Palo Alto Yacht Harbor is a one-acre pond with a related sanctuary zone. The pond attracts migratory waterfowl as well as indigenous waterfowl and shorebirds. Associated with it is a 13-acre lagoon, formerly a portion of Mayfield Slough, which was the estuary of San Francisquito Creek. Previously closed to tidal action, the lagoon, now stagnant, will be opened to tidal action as a salt marsh demonstration project, with the goal of reestablishing the natural biota of the slough when the project is implemented. The duck pond and lagoon are used heavily by area residents throughout the year, particularly in the winter months, when hundreds of migratory waterfowl winter in the area.

The Palo Alto treatment plant is located south of the yacht harbor (Santa Clara County Planning Department, 1972). To the east of this plant is the municipal refuse area which is the only area of the city's Baylands above the 10-foot elevation. It is presently estimated that the sanitary landfill site of 150 acres will be filled by 1983 (Santa Clara County Planning Department, 1972). If this area is still needed for refuse disposal, another layer of 10 to 20 feet could be added, which would take care of the city's disposal needs until the year 2000. This land has been dedicated as a public park, but specific uses have not been assigned. A golf course has been suggested as one major use.

An International Telephone and Telegraph Company (ITT) receiving network occupies an area of 154 acres of land between the refuse area and the Bayshore Freeway. The area is unincorporated and is entirely surrounded by the City of Palo Alto (Santa Clara County Planning Department, 1972).

All of the Marshland Preserve and recreational areas described above are surrounded by a perimeter levee, portions of which have been built and maintained by the Flood Control and Water District (Santa Clara County Planning Department, 1972). Much of this area is open for public use as nature and hiking trails.

San Francisquito Creek, a flood control channel, is bordered by the Palo Alto Municipal Golf Course in the Palo Alto Baylands and by the Faber Tract across the channel in San Mateo County (Santa Clara County Planning Department, 1972). Hook Island is a 35-acre island of cord grass salt marsh that is completely inundated by the tides. The Sand Point Marsh, encompassing 120 acres, is the major marsh in Palo Alto's Baylands. It is composed of cord grass, pickleweed, and salt grass from its lowest to highest elevations.

Sand Point Marsh is important ecologically, particularly for its food value, wildlife habitat, and reoxygenation of Bay waters. Two endangered species, the California clapper rail and the salt marsh harvest mouse, as well as other rare and threatened species, are thought to inhabit the marsh (Section II.1.2).

The open water off the Bay shoreline is zoned by the City of Palo Alto as a flood area (Santa Clara County Planning Department, 1972). Ownership is claimed by the Ideal Cement Company, although the title status may be subject to dispute by the state.

Both the Faber and Laumeister Tracts are parcels of Baylands in San Mateo County owned by the City of Palo Alto. Both have been designated as Marshland Preserves. The 120-acre Laumeister Tract is an undisturbed marsh, while the 100-acre Faber Tract, a salt marsh once diked and used for grazing, is now open to tidal action and is reestablishing itself.

Foster City and East Palo Alto are the major Baylands communities in San Mateo County in the area north of the San Mateo/Santa Clara County line, south of the San Mateo Bridge, and east of the Bayshore Freeway, although small portions of Menlo Park, Redwood City, San Carlos, Belmont, and San Mateo are also in this area. The public and private facilities in this area are discussed due to their proximity to the proposed pipeline outfall north of the Dumbarton Bridge.

Cooley Landing is located on a peninsula jutting into the Bay from East Palo Alto at the end of Bay Road in the city limits of Menlo Park. Most of the landing is owned by a ship repair facility. The owner is planning a modern aquatic park and yacht harbor.

A 60-acre marshland located north of the west abutment of the existing Dumbarton Bridge is presently being utilized as a duck club (California Business and Transportation Agency, 1973). This salt marsh is diked off from the Bay and is not exposed to tidal fluctuations. The marsh remains dry for most of the year until duck season begins, when the marsh is flooded with fresh water. The fresh water attracts migrating ducks for resting and feeding. This marsh area is part of the San Francisco Bay National Wildlife Refuge and is proposed as a site for a nature interpretative center to serve the local communities.

The Southern Pacific Railroad Bridge is approximately 3,800 feet south of the Dumbarton Bridge (California Business and Transportation Agency, 1973). The single-track bridge consists of steel truss sections with a swing span over the shipping channel. The west approach goes through marshland that has been partially filled and developed.

The Hetch Hetchy Aqueduct crosses San Francisco Bay just to the north of the Southern Pacific Railroad Bridge. This aqueduct, about 3,000 feet south of the Dumbarton Bridge, consists of an over-water steel truss section 4,000 feet long, an underwater section 400 feet long, and the Dumbarton pumping station.

After the aqueduct pipes reach the west shoreline, they continue above the ground for approximately a half mile. Approximately 800 feet from the point where the proposed Embarcadero Freeway connection crosses the Southern Pacific Railroad tracks, the pipes go underground and continue through San Mateo County to Upper Crystal Springs Reservoir (California Business and Transportation Agency, 1973).

The existing west approach road to the Dumbarton Bridge is built on fill that borders the salt ponds. The west approach road is built over timber culverts, equipped with movable gates, which allow movement of saltwater between salt ponds on each side of the roadway.

Greco Island, a saltwater marshland, lies to the east of Westpoint Slough. It is a known feeding and nesting area of the California clapper rail, an endangered species. The island is included in the San Francisco Bay National Wildlife Refuge.

The Redwood Shores development lies along Belmont Channel in Redwood City. The homes are predominantly single-family residences built since 1968. The Redwood Shores development has waterfront property and provides access for water sports such as swimming and sailing.

The Belmont City limits includes the strip of land fronting the east side of Highway 101, halfway between the Ralston interchange and the Holly Street interchange. The lands consist of an industrial/commercial area, open space, and a small saltwater marsh area.

Foster City is comprised of the filled area to the west of Marina Lagoon and to the north of Belmont Slough. The majority of the area is residential and open space. Foster City Park is a bayfront beach consisting of oyster shell fragments and Bay Mud. The beach is set off from Foster City by a levee supporting local grasses and shrubs.

The Leslie Salt Company is the largest single property owner in the Baylands study area, having a total of 8,700 acres, of which 7,700 acres are in salt ponds (Santa Clara County Planning Department, 1972). These ponds constitute a small but key portion of its San Francisco Bay holdings in four counties, which total close of 50,000 acres (see Section II.1.2 for a discussion of salt ponds).

Fostered by the ad hoc South San Francisco Baylands Planning, Conservation, and National Wildlife Refuge Committee, studied by the Bureau of Outdoor Recreation and the U.S. Fish and Wildlife Service, and supported by the Department of Interior in congressional hearings on bills to establish it, the San Francisco Bay National Wildlife Refuge received congressional approval in the spring of 1972, and the legislation was signed by the President on June 20, 1972. Primary funds for acquisition and development come from the Migratory Bird Conservation ("duck stamp") Fund and the Land and Water Conservation Funds for endangered species.

The refuge is located in three counties — Alameda, San Mateo, and Santa Clara — and in the Cities of Fremont, Redwood City, Menlo Park, and San Jose (Figure II-24). It traverses nine major habitats in the South San Francisco Bay Area; salt marshes, mud flats, shallow water, deep water, diked marshlands, brackish marshes, wet salt ponds, dry salt ponds, and landfill. The portion in Santa Clara County extends from the Alviso Slough eastward, including all of the salt ponds and a portion of the New Chicago Marsh east of the new railroad spur, and is approximately 3,000 acres in area. In support of the refuge, the San Jose City Council reclassified the zoning of the area from industrial to agricultural, its most restrictive use-district classification.

In San Mateo County, the wildlife refuge consists of the Bair and Greco Islands and Ravenswood Point areas of Redwood City and Menlo Park. Redwood City has requested that the U.S. Fish and Wildlife Service include the Bird Island area as well.

Leaseback privileges to the Leslie Salt Company permit continued salt production. Past curtailment of salt production elsewhere on San Francisco Bay, and the draining and subsequent filling of other salt ponds for commercial and residential development, has contributed, in part, to the widespread support of the wildlife refuge concept. There are three primary objectives of the refuge. The most important is to preserve the natural resources of the South Bay, which include the habitat of migratory birds, mammals, fish, endangered species, and flora. The second is to provide educational opportunities to Bay Area schools and residents. The third is to protect important open space and wildlife-oriented recreation opportunities for human use and enjoyment

Mineral Resources of the Baylands

Mineral resources of Santa Clara County are of three kinds (Bechtel, 1974):

- Those minerals used in the construction industry — limestone used in the manufacture of cement and rock, sand, and gravel used for road base construction or for concrete
- Other minerals used in the manufacture of metal or other products
- Salt obtained from solar evaporation

With the exception of salt production, an insignificant portion of these minerals exists in the study area (for a discussion of the salt industry see Sections II.1.2 and II.2.1).

II.2.2 PROJECTED LAND-USE PATTERNS

Planned Public and Private Developments

Baylands run a high risk of saltwater flooding in the event of a major levee failure. Therefore, further land uses in the area may be similar to present land uses (i.e., less than 10 percent residential, industrial, transportation, utilities, commercial, and public, with the balance being agricultural, marshes, salt ponds, and bay water).

In the City of San Jose, plans are being made for:

- The creation of a special marine district for water-related industrial and commercial activities
- The "Alviso Bay" project, which includes the development of the salt ponds in the area between Alviso and Guadalupe Sloughs for recreational purposes (Santa Clara County Planning Department, 1972; San Jose City Council, 1970)

The 135-acre refuse fill area near the salt ponds in Sunnyvale is designated for recreational and park use (Sunnyvale Baylands Park), and the city intends a joint development program with the county.

The Navy, at Moffett Field, intends to continue current levels of operation at least until 1980, although no major changes in facilities or land use are foreseen. Flight clearance requirements for the runway impose constraints on future change of use or development of the salt ponds off the runway.

At the Ames Research Center, NASA has acquired adjacent parcels for an anticipated expansion to the north and west of its current property, although there is still some uncertainty about these plans. A 1976 master plan guiding this development includes a drainage system in the northernmost part of the site, where two magnetic research facilities are being developed, and a pond, where cooling tower waters could be treated before discharge into Stevens Creek.

The City of Palo Alto plans to convert the Flood Retention Basin to a wildlife preserve by selective dredging

Table II-22

PROJECTED LAND-USE PATTERNS, 1975-2000, FOR SANTA CLARA AND SAN MATEO COUNTIES

(Land Area — Thousands of Acres) (SWRCB and RWQCB, 1974)

	1970	1975	1980	1990	2000	Change 1970 - 2000
Santa Clara County						
Residential	66.7	80.0	93.2	99.2	124.2	57.5
Commercial	23.0	24.6	27.9	24.6	23.5	0.5
Industrial	24.5	26.5	25.3	29.1	31.9	7.4
Net Irrigable	37.8	33.3	29.3	22.0	16.2	-21.6
Irrigable Remaining	101.6	89.0	78.1	76.5	55.7	-45.9
Remaining Nonirrigable Suitable for Urban Use	44.7	29.4	15.8	9.4	10.9	-33.8
Remaining	431.0	429.0	427.6	427.6	399.2	-31.8
Total	589.9					
San Mateo County						
Residential	39.0	44.1	51.8	63.5	67.9	28.9
Commercial	7.3	8.1	8.8	9.2	9.8	2.5
Industrial	6.7	7.7	8.7	10.1	11.7	5.0
Net Irrigable	2.9	2.6	2.9	2.4	2.0	-0.9
Irrigable Remaining	21.3	21.1	20.4	17.7	15.3	-6.0
Remaining Nonirrigable Suitable for Urban Use	28.8	22.5	14.4	2.7	1.7	-27.1
Remaining	224.1	223.4	222.3	220.3	214.7	-9.4
Total	305.9					

Land-use categories are defined as follows:

- Residential — gross acreage in residential use, including single and multiple dwelling units, roads, and streets.
- Commercial — gross acreage occupied by local-serving establishments, including shopping centers, strip commercial and business districts, roads, and streets.
- Industrial — gross acreage occupied by establishments in basic industries, including manufacturing, wholesale trade, transportation, and utilities, roads, and streets.
- Net irrigable — acreage of any agricultural land on which water is applied to grow crops.
- Irrigable Remaining — all vacant land under 25- to 30-percent slope with effective rooting depth of roughly one foot or more
- Remaining Nonirrigable — not suitable for irrigated agriculture, including industrial available, other available, and noninfrastructure vacant.
- Remaining — difference between total land and the sum of the categories: residential, commercial, industrial, and remaining nonirrigable suitable for urban use. Does not include net irrigable and irrigable remaining.

to create island sanctuaries and mounds and by the introduction of compatible salt-tolerant plants to increase the habitat diversity and food supply and variety. This will allow greater use of the wetlands by species already present and encourage others to inhabit the basin.

The replacement of the Dumbarton Bridge (California Business and Transportation Agency, 1973) has been approved and will soon be underway.

In San Mateo County, projected land use in the Baylands is subject to many possible variations. The development of the Greco Island and Bair Island portions of the San Francisco Bay National Wildlife Refuge is progressing to enable greater public access to the area (see Section II.2.1).

The expansion of residential and commercial land uses in the Foster City and Bayshore Estates areas is expected to continue, thus constituting a greater population in the San Mateo County Baylands area. A doubling of residential use is projected for both counties, while significant decreases in agricultural lands are expected for Santa Clara County.

Table II-22 and Figure II-25 present the projected land-use characteristics of those portions of Santa Clara and San Mateo Counties within Hydrological Basin 2 designated by the State Water Resources Control Board.

Land-Use Plans and Planning Agencies

Analysis of the general plans of the jurisdictions in the study area indicates various discrepancies existing within and between the land-use plans.

Specifically, some of the land uses permitted in some districts are general in scope and have not always addressed the use of lands that are susceptible to flooding or inundation. In addition, land uses have not always been designated in the interest of the area's ecology, in the interest of protecting persons and property from haphazard development, and in the interest of protecting the communities from the costs that might be incurred if unsuitable development occurs in these areas.

The importance of the Baylands and the estuary as a natural resource has been recognized by federal, state, and local government. While any future development is constrained by requirements at all levels, the ultimate development decision is a local matter and may vary from county to county.

Figure II-25 presents the generalized projected use of land in the Baylands.

The Bayfront Plan of the County of Santa Clara (Santa Clara County Planning Department, 1972) formulated in July 1972, was an attempt to establish a unified set of goals and policies for Baylands development and to analyze the impact of such development on resources, public funds, and future needs of the county. The plan proposed that the innermost levees, between the salt ponds and the mainland, be raised and widened to an average width of 1,000 feet. Vehicular access to points along the levees was proposed by similarly widening certain levees along the flood channels leading from the valley floor to the Bay. The raising and widening of the land barrier was proposed to be accomplished by dredging existing channels and the Bay floor beyond the low water tidal flats in the amount of approximately 30 million cubic yards. The Bayfront Plan was opposed by many groups and was not approved by the Santa Clara County Board of Supervisors.

In March 1972, a Plan of Regional Parks for Santa Clara County was published by the County Planning Department (Santa Clara County Planning Department, 1972a). Developed in cooperation with the Parks and Recreation Department and two subcommittees of the Planning Policy Committee, the plan provided for the development of 13 Baylands sites:

- Palo Alto Yacht Harbor
- Palo Alto Flood Basin

- Charleston Slough Wildlife Preserve
- Shoreline Park
- Mountain View Shoreline Park
- Guadalupe Yacht Harbor
- San Francisco Bay National Wildlife Refuge
- New Chicago Park
- Sunnyvale-Santa Clara Baylands Park
- Santa Clara Valley Floor Park
- Alviso Marina County Park
- Guadalupe River Chain
- Coyote Creek Park Chain

Dedication of the Baylands for park and recreational purposes provides for public control and management over the ecologically valuable but fragile bayfront, marshes, meadows, and shorelines for the public welfare. Recent public awareness of the delicate but vital ecological importance of the Baylands and related mud flats and waters has led to the reexamination of past policies and goals for the Baylands. Therefore, the emphasis is on retention and preservation of the natural areas remaining in the Baylands and on recreation activities only when they are compatible with higher priority conservation goals (Santa Clara County Planning Department, 1972a).

The general plan of 1975 (amended 1977) adopted by the City of San Jose (City of San Jose, 1977) allocates the Baylands area primarily to public, quasi-public, and private parks and open space, with some urban (residential and commercial) use in the Alviso Planning Unit. The Alviso area is treated as a special area of concern, with many uses constrained by physical factors (wetlands, salt ponds, and the presence of the National Wildlife Refuge and the San Jose/Santa Clara water pollution control plant, and solid waste disposal sites). The plan includes development of an Alviso Environmental Education Center east of town as well as a Visitor Center in the Alviso Marina.

The general plan adopted by the City of Santa Clara in 1970 (Santa Clara City Council, 1970) allocates the Baylands primarily to industrial uses, with some residential uses south of Route 237 (Santa Clara County Planning Department, 1972). A park area bordering the Guadalupe River and Route 237 — Santa Clara County Valley Floor Park — is indicated in the general plan. Due to current development proposals on a portion of this site, city officials are tending to favor industrial use of this land. However, the site remains in the county's park program on a long-term basis.

The proposed Sunnyvale-Santa Clara Baylands Park is under consideration as an intensive recreational area. Located north of Caribbean Road near the current Sunnyvale treatment plant, the site is partly owned by the city and is being reserved under agreement with the county as a regional park.

The Mountain View Shoreline Park, a 550-acre park with a variety of planned recreational facilities, was acquired jointly by the City of Mountain View and Santa Clara County with federal open space matching funds. The remaining 850 acres between the Mountain View Shoreline Park and the Bayshore Freeway (U.S. 101) have been under planning review by the Environmental Planning Commission of the City of Mountain View. The two salt ponds north of the Mountain View Shoreline Park are not presently within the city limits, but are within the city's sphere of influence. The Mountain View General Plan (Mountain View Planning Department, 1972) provides that the Bay and this area remain indefinitely in open, undeveloped water uses.

The City of Palo Alto's comprehensive General Plan was approved in November 1976. However, basic concepts pertaining to recreation, city facilities, and some urban uses remain unchanged from the 1964 General Plan. The Palo Alto Flood Retention Basin, a meadow area used by the wildlife for nesting and resting, is a wetland in the rainy season but a dry meadow most of the year. Its 600 acres are to be preserved in a natural state as long as it is consistent with flood control requirements and is designated "City and County Conservation" in the 1976 Comprehensive Plan.

LEGEND

☐ Residential

■ Industrial – Commercial – Including Airports

■ Recreation, including City Parks, Golf Courses, Buffer Zones, and Open Space

■ Baylands Wildlife Habitat, including Salt Ponds and Marshes, with Limited Recreational Use

■ U.S. Government, State Government Facilities

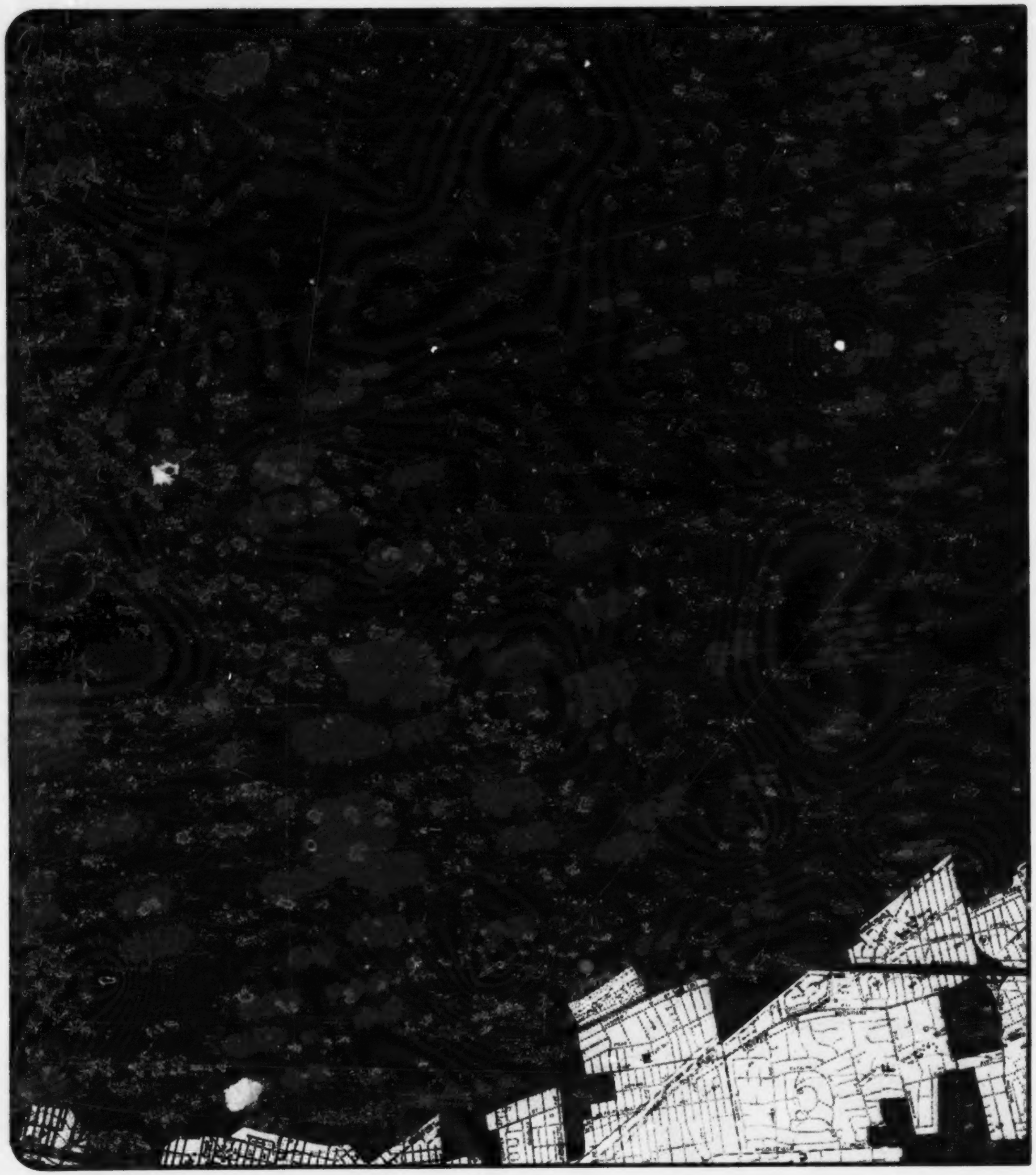
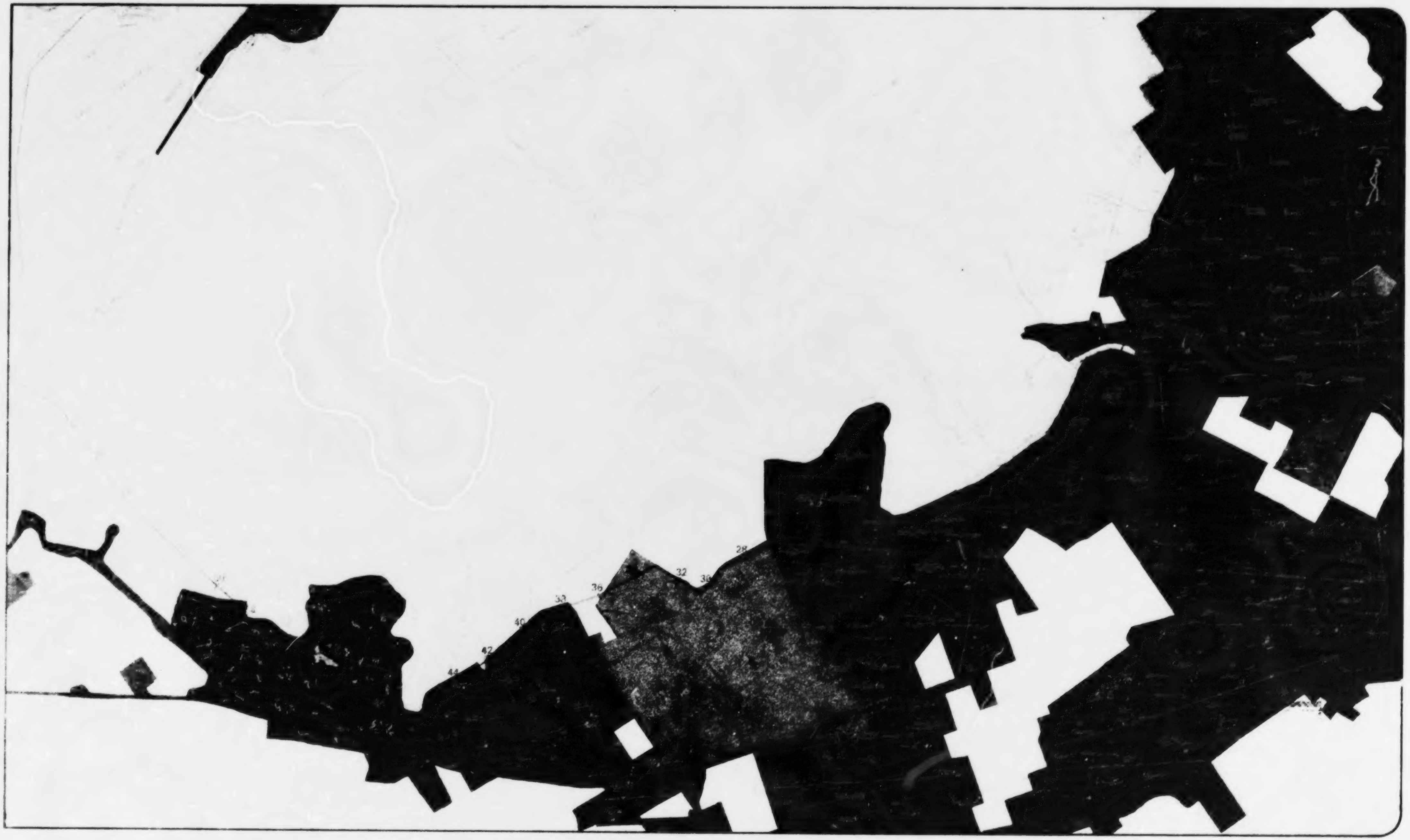


Figure II-25 FUTURE LAND USE


28
32
30
36
38
40
42
44

Interested Agencies

There are a number of agencies on the local, regional, state, and federal levels with the capability to exert a major influence on the planning and control of water resources in the San Francisco Bay Area. The controls they exercise are as follows:

Local. Except in the areas of water quality standards and permit procedures required for development on the county shorelines, control of the water resources in Santa Clara County is a local option. The county can sponsor, regulate, or manage, with federal and/or state technical and financial assistance, the implementation of flood plain management, water conservation and development, correction of erosion, harbor construction and channel dredging, water-related recreational facilities, and other controls and programs.

Local controls and responsibilities also extend to the use of water involving public health. Maintenance of water bodies within the local jurisdictions through proper wastewater treatment is a local responsibility. Although affected to a considerable extend by RWQCB policy and SWRCB standards, regulations regarding the use and design of septic tanks and the taking of groundwater is a local environmental health concern.

The County Planning Commission of Santa Clara develops studies, accumulates data, and aids in the implementation of various development plans and programs. The commission provides an important impetus and suggests courses of actions for future development of the county. Planning departments within each city in the study area provide similar services on a more local scale.

Regional. On a regional level, the following agency is concrened:

- Association of Bay Area Governments (ABAG) is a council of local governments — an extension of local government to the regional level. It is the areawide comprehensive planning agency for the Bay Area, and its approved regional plan provides a policy framework for regional planning. ABAG is the federally designated metropolitan clearinghouse for the Bay Area. It also reviews and comments on federal development projects and environmental impact statements as required by federal and state law for projects in the region. Projects with regional impact are examined in relation to the approved regional plan. ABAG was responsible for developing the *Draft Environmental Management Plan for the San Francisco Bay Region* (ABAG, 1977a).

State. The State of California has a number of agencies that provide planning and regulate the water resources in the Bay. These include the Department of Water Resources, the State Water Resources Control Board, and the Department of Navigation and Ocean Development. Other state agencies include:

- Regional Water Quality Control Board (RWQCB). The RWQCB sets standards necessary to protect water quality and issues National Pollutant Discharge Elimination System (NPDES) permits to dischargers.

- Bay Conservation and Development Commission (BCDC). This organization has the responsibility to insure that Bay and shoreline development is directly related to use of the Bay as a waterway.

  - Some Bay filling may be justified for purposes providing substantial public benefits that are directly related to the Bay, if these same benefits could not be achieved equally well without filling.

  - Minor amounts of filling may be permitted, if necessary, to improve the attractiveness of shoreline developments or to make possible additional recreational areas of the waterfront, if these improvements to shoreline development could not be achieved without filling.

- Coastal Zone Conservation Commission. The Commission is authorized to:
  - Study the coastal zone and its resources
  - Prepare a state plan for its orderly, long-range conservation and management
  - Regulate development by a permit system while the plan is being developed

Federal. The federal agencies include:

- U.S. Army Corps of Engineers. All physical alterations in the "navigable waters" of the U.S. will require a permit from the U.S. Army Corps of Engineers.
- U.S. Soil Conservation Service. This agency, under the U.S. Department of Agriculture, has its primary mission to insure the conservation and wise development of land and water resources through a variety of programs that are fact-finding and advisory in character.
- U.S. Geological Survey. This agency has no regulatory powers but is a fact-finding agency concerned with hydrological conditions in the Bay as well as geological conditions in the Bay Area.
- U.S. Coast Guard. This agency supervises the handling and cleanup of petroleum products in navigable waterways.
- U.S. Environmental Protection Agency. The EPA National Pollutant Discharge Elimination System (NPDES) permit program has been delegated to the California SWRCB. In conjunction with the SWRCB, the EPA makes grants for the construction of wastewater treatment works.

II.3.1 EXISTING AND PROPOSED WASTEWATER TREATMENT FACILITIES

The wastewater treatment plants in Santa Clara, Alameda, and San Mateo Counties discharging to the Bay south of the San Mateo Bridge are described below. The water quality in the South Bay (Section II.1.1) is directly related to the quality and quantity of effluent produced by these plants.

San Jose/Santa Clara Regional Water Pollution Control Plant

The plant is located approximately five miles north of the San Jose central business area at the intersection of Los Esteros and Zanker Roads on lands owned by the City of San Jose. Effluent is discharged to Artesian Slough, which flows into Coyote Creek and then into the Bay.

The service area tributary to the treatment plant includes the Cities of San Jose and Santa Clara and the major portion of the Santa Clara Valley. This area covers about 300 square miles and includes the incorporated communities of Campbell, Cupertino, Los Gatos, Monte Sereno, and Saratoga. Other areas served are County Sanitation Districts 2, 3, and 4, and Burbank, Cupertino, Milpitas, and Sunol Sanitary Districts.

The San Jose/Santa Clara treatment plant is an activated sludge plant employing the Kraus nitrified sludge interchange process. Existing facilities include screening, grit removal, primary and secondary sedimentation, aeration, digestion, sludge concentration, sludge lagoons, chlorination facilities, and sludge disposal facilities. The existing San Jose/Santa Clara treatment plant has complete primary and secondary treatment facilities and consistently achieves a BOD (biochemical oxygen demand) removal of 90 percent.

Expansion of the plant facilities to an average hydraulic capacity of 160 million gallons per day (mgd) is now complete. The additional plant facilities provide primary and secondary treatment for the sustained seasonal flow and will handle the peak wet-weather flows for the year 1985. Units included in this construction program are additional screens, grit removal tanks, primary settling tanks, aeration tanks, final sedimentation tanks, and new nitrification tanks.

Advanced wastewater treatment facilities are nearing completion. These improvements include additional settling capacity, biological nitrification, and dual-media filtration designed for a flow of 143 mgd.

Dry-weather flows during the noncanning season averaged about 80 mgd in 1974 (Bechtel, 1974). During the canning season, the flow increased to approximately 92 mgd. The present daily discharge of BOD is about 20,000 pounds.

Expected effluent characteristics in 1995 from the planned facilities include a BOD of 10 mg/l, suspended solids of 5 mg/l, ammonia of 1.5 mg/l as N, and a UOD (ultimate oxygen demand) of 63,500 pounds per day.

Sunnyvale Water Pollution Control Plant

The plant is located at the north end of Borregas Avenue, within the Baylands on Sunnyvale Slough. Effluent is discharged into Guadalupe Slough. The Sunnyvale treatment plant is a secondary facility having primary sedimentation tanks, oxidation ponds with aerators and recirculation, and a 200-million-gallon holding pond for cannery wastes. The plant can be operated to provide separate treatment of domestic and cannery wastes. In present operating procedure, domestic and cannery wastes are treated separately through the primary stages. The two primary effluents are then mixed and conveyed to oxidation ponds for secondary biological treatment.

Improvements added in the summer of 1978 include filtration, flotation, dechlorination, and biological nitrification.

The 1972-1973 average annual flow, exclusive of cannery wastes, was 15.5 mgd. During the canning season, an additional load of up to 9 mgd may occur. This waste is carried to the plant in a separate industrial waste sewer. The plant presently has a primary treatment design capacity for an average dry-weather flow of 22.5 mdg. Effluent characteristics from the present facilities include an annual average BOD of 37 mg/l, suspended solids of 82 mg/l, and a BOD loading of about 5,000 pounds per day.

Expected effluent characteristics in 1995 from the improved facilities include BOD of 5 mg/l, suspended solids of 2 mg/l, and NH_3-N at 4 mg/l.

Palo Alto Treatment Plant

The City of Palo Alto recently completed a regional treatment plant to provide secondary treatment to the wastes of Palo Alto, Mountain View, and Los Altos. This activated sludge plant also serves Stanford University, Barron Park, East Palo Alto Sanitary District, Los Altos Hills, and Las Encinas Sanitary District. The plant is located on Embarcadero Road across from the Palo Alto Airport. The discharge is to a dredged channel about 1,500 feet out into the Bay, north of the Palo Alto Airport.

The Palo Alto regional treatment plant is designed for an overall BOD removal of 90 percent, with an anticipated effluent concentration of less than 20 mg/l BOD and 20 mg/l suspended solids. Facilities include an influent pumping station, additional bar screens, primary and final clarifiers, aeration tanks, digesters, thickeners, and chlorination facilities. Sludge disposal is by centrifugal dewatering followed by incineration in two multiple-hearth furnaces.

An additional feature of the Palo Alto regional plant is an industrial waste treatment facility, separate from the main plant. It treats chemical wastes such as acids, cyanides, and solvents brought to the facility in tank trucks.

Improvements currently being made include biological nitrification and filtration.

Current design capacity is 35 mgd, and the average dry-weather flow is 22.1 mgd. The daily discharge of ultimate oxygen demand (UOD) in 1974 was about 30,000 pounds.

Expected effluent characteristics in 1995 from the improved facilities include BOD of 12 mg/l, suspended solids of 10 mg/l, and ammonia nitrogen of 5.4 mg/l.

Menlo Park Sanitary District Wastewater Treatment Plant

The Menlo Park Sanitary District treatment plant is located at the east end of Marsh Road in Menlo Park. The plant is designed to handle 8.0 mgd and currently handles 5.9 mgd. The facility provides preaeration and has six primary settling chambers. The effluent flows to aeration lagoons before it is chlorinated and transmitted, twice daily, to the mouth of Ravenswood Slough and Westpoint Slough. Current plans are for the Menlo Park Sanitary District to join with the South Bayside system (SCSP Committee, 1974), a subregional plant at Redwood Shores, disposing at an existing Bay outfall.

Redwood City Sanitary District - Redwood City Sewage Treatment Facility

The Redwood City treatment plant is located east of the Bayshore Freeway next to Redwood Creek in Redwood City. The plant has primary sedimentation followed by a secondary clarifier and biofilter. The sewage is chlorinated prior to discharge through the new joint outfall with the Belmont-San Carlos plant to the deep water channel east of the mouth of Steinberger Slough, approximately 7,000 feet offshore into 45 feet of water. This facility will be abandoned, and Redwood City will join in the South Bayside subregional plant at Redwood shores (SCSP Committee, 1974).

Redwood City Sanitary District — Redwood Shores Plant

This plant is located at the mouth of Steinberger Slough and services the Redwood City General Improvement District (Redwood Shores). The plant consists of a set of oxidation ponds. All wastewater is evaporated, and the facility has no discharge at present. This facility will be abandoned and all wastes pumped to a new subregional plant at Redwood Shores (SCSP Committee, 1974).

Belmont/San Carlos Joint Sewage Treatment Facility

This plant, located in San Carlos, provides partial secondary treatment and is located east of Bayshore Freeway, next to the county airport. The plant consists of a primary clarifier, a single biofilter, and a secondary clarifier. The sludge from the clarifiers is treated in an anaerobic digester, dewatered by centrifuging, and disposed of on land. Chlorinated effluent is discharged through the joint Belmont/San Carlos/Redwood City outfall. This facility will be abandoned, and wastes will be conveyed for treatment at the Redwood Shores subregional plant (SCSP Committee, 1974).

Proposed Redwood Shores Subregional Plant

This proposed plant, on 20 acres near the mouth of Steinberger Slough, will receive effluent from the existing Menlo Park, Redwood City, Redwood Shores, and Belmont/San Carlos treatment plants. As described by the Strategic Consolidation Sewerage Plan (SCSP) Steering Committee (1974), the new plant will provide full biological treatment, including nitrification, followed by filtration, chlorination, and dechlorination. Projected average daily flows (1995) of 23.1 mgd will be disposed through the existing outfall of Redwood Peninsula, now utilized by the Redwood City and Belmont/San Carlos plants.

Union Sanitary District — Alvarado, Plant No. 3

The Union Sanitary District (Alvarado Plant No. 3) is located at 5072 Benson Road in Union City. The facility consists of influent pumping, barminution, a vacuator for primary solids removal, aeration, final sedimentation, chlorination, and a chlorine contact tank. Sludge is digested anaerobically and disposed of as a solid waste after drying on open drying beds at the plant site. The plant effluent is discharged to Alameda Creek at a point three miles from the Bay. The Union Sanitary District is participating as a member of the East Bay Dischargers Authority, which is presently developing a regional wastewater management plant that includes regional treatment and common conveyance to a point in the Bay north of San Mateo Bridge (EPA, 1975c).

Union Sanitary District — Newark, Plant No. 1

The Newark treatment plant (Plant No. 1), located at 8700 Thornton Avenue in Newark, utilizes high-rate activated sludge for partial secondary treatment. The plant sludge is anaerobically digested, dewatered by centrifuge, and disposed of as a solid waste. Treated effluent, after disinfection, is discharged to Newark Slough, a Bay tributary. This facility will be closed upon completion of the East Bay Dischargers Authority project (EPA, 1975c).

Union Sanitary District — Irvington, Plant No. 2

The Irvington treatment plant (Plant No. 2), located at 46525 Landing Road in Fremont, utilizes a single high-rate biofilter for partial secondary treatment. The effluent is disinfected and then discharged to Mud Slough, which feeds into the Bay. Digested sludge is air dried and disposed of as a solid waste. The Irvington plant will also be closed upon the completion of the East Bay Dischargers project (EPA, 1975c).

II.3.2 CURRENT AND PROJECTED SOURCES OF WATER

Water used in north Santa Clara County is supplied from imported and local sources, as shown in Tables II-23 and II-24. Two systems, the South Bay Aqueduct, a portion of the State Water Project, and the San Francisco Water District's Hetch Hetchy Aqueduct supply imported water. In 1975, the South Bay Aqueduct supplied about

100,000 acre-feet per year and the Hetch Hetchy supplied 50,000 acre-feet per year. South Bay Aqueduct water deliveries by month and delivery point are shown in Table II-24. In the future, deliveries from the South Bay Aqueduct are not expected to increase, but deliveries from Hetch Hetchy can increase to between 64,000 (Santa Clara Valley Water District Master Plan) and 73,000 (SWRCB and RWQCB, 1974) acre-feet per year.

Table II-23

SOURCES OF WATER SUPPLY
FOR THE SANTA CLARA VALLEY
(SWRCB, 1974)

Source	1970 Delivery (acre-feet per year)	Present Upper Limit(1) (acre-feet per year)
San Francisco Water District Aqueduct	48,000	73,000
South Bay Aqueduct	88,000	100,000
Local surface water(2)	65,000	65,000
Estimated groundwater yield	120,000	120,000
Total	321,000	358,000

Notes:
(1) Limiting factor can be facility, contractual, or yield constraint.

(2) Including surface runoff, stream flows, and other bodies of surface waters.

Local sources include surface and groundwater. The Santa Clara Valley Water District operates a series of surface storage reservoirs to impound water for groundwater recharge. About half of the South Bay Aqueduct water is used for groundwater recharge (see Table II-25), with total recharge to the Santa Clara groundwater basin averaging 140,000 acre-feet per year (SWRCB and RWQCB, 1974), and a total recharge capability of 143,200 acre-feet per year in the Santa Clara, Coyote, and Llagas basins (Santa Clara Valley Water District Master Plan).

Additional proposed sources of water for the Santa Clara Valley Water District are imported water from the San Felipe Project and augmented surface water supplies by the Santa Clara County weather modification program. The reader is referred to the SCVWD Draft EIR (Environmental Science Associates, 1974), the Bureau of Reclamation Draft EIS (1975) on the San Felipe Project, the USBR Final EIS on San Felipe (1976), and the Santa Clara County Draft EIR (1975) on weather modification for details. Briefly, the San Felipe Project is a proposed water distribution system authorized by the U.S. Bureau of Reclamation. The system would transport waters from the Bay Delta to Santa Clara Valley. Annual water demand to be satisfied by this project is currently projected as 185,000 acre-feet (Environmental Science Associates, 1974). Augmentation of surface water supplies through increased precipitation is the purpose of the weather modification program; as much as a 13 percent increase in average rainfall, or 15,000 acre-feet annually, is projected for this program (Environmental Science Associates, 1975).

II.3.3 CURRENT WATER USE AND PROJECTED DEMAND

Several estimates of future water demand in Santa Clara County have been made using different assumptions for population growth, growth in use per capita, and other projections. Table II-26 shows projected residential water demand by planning area with no projected increase in per capita demand. Tables II-27 and II-28 show two water use projections through the year 2000, as reported by the Santa Clara Valley Water District (Environmental Science Associates, 1974).

II.3.4 CURRENT AND PROJECTED WATER QUALITY

Water supplies in Santa Clara Valley are generally of good quality and are satisfactory for all uses. Table II-29 lists the concentrations of total dissolved

Table II-24
EXISTING WATER SUPPLY FACILITIES, SANTA CLARA COUNTY
(SWRCB and RWQCB, 1974)

Agency	Source	Population Served	Total Supplied (mgd)
California Water Service Co.	South Bay Aqueduct, Wells	35,000	10.4
Campbell Water Co.	Wells	19,000	2.79
Cupertino, City of	Wells, South Bay Aqued., Stevens Cr. Res.	5,000	1.00
Great Oaks Water Co.	Wells	22,500	3.31
Magic Sands Mobile Home Park	Wells	600	0.04
Milpitas, City of	San Francisco Water District (SFWD)	29,560	4.57
Mountain View, City of	SFWD, Wells	62,500	12.5
North Los Altos Water Co.	Wells	4,940	0.80
Palo Alto, City of	SFWD	62,102	16.7
Purissima Hills Co. Water District	SFWD	4,680	0.97
Redwood Mutual Water Co.	Springs, Wells	1,300	0.05
San Jose, City of	Wells, South Bay Aqued., SFWD, SCVWD	30,000	>4.00
San Jose Highlands Water Company	Wells	645	0.05
San Jose Waterworks	South Bay Aqued., Wells, SCVWD	496,000	96.2
Santa Clara, City of	South Bay Aqued., Wells, SCVWD	85,000	15.2
Saratoga Heights Mutual Water Co.	South Bay Aqued., SCFWD	375	0.05
Stanford University	SFWD, Wells	20,000	3.10
Sunnyvale, City of	SFWD, South Bay Aqued., Wells	104,000	17.1
Santa Clara Valley Water District	Almaden, Anderson, Calero, Coyote, Guadalupe, Lexington, Stevens Cr. Res.	Supplies water to other agencies	

solids in imported water. Quality of water from Hetch Hetchy is expected to remain stable, since the source is in the Sierra Nevada Mountains and will likely be protected from degradation by watershed development (Environmental Science Associates, 1974). Water imported via the South Bay Aqueduct may have reduced quality in future years. Currently, concentrations of total dissolved solids (TDS) average about 350 mg/l. The TDS concentration may increase in future years due to poor quality agricultural return water to the Sacramento/San Joaquin Delta from the San Joaquin Valley and due to salinity intrusion into the western Delta.

A summary of groundwater quality in the county is given in Table II-30. Historically, saltwater intrusion and reduction in groundwater quality have been problems in upper aquifers (to a 150 foot depth), but recharge projects in recent years have stabilized saltwater intrusion. Groundwater quality is expected to remain relatively constant.

The water quality of Coyote and Uvas Creeks, said to be typical of local surface waters in the county (Environmental Sciences Associates, 1974), is shown in Table II-31. While local surface water quality is subject to quality reductions due to human practices, seasonal low flows, and channel disturbances, watershed management practices are expected to stabilize local surface water quality in future years.

Table II-25

SOUTH BAY AQUEDUCT WATER DELIVERIES
(Fiscal Year 1974-75)
(SWRCB and RWQCB, 1974)

Month	Deliveries (acre-feet)	Delivered to Treatment Plant(1)	Agricultural and Groundwater Recharge
July	10,564	7,135	3,429
Aug.	11,022	8,124	2,898
Sept.	10,701	7,262	3,439
Oct.	10,786	5,797	4,989
Nov.	8,152	4,339	3,813
Dec.	7,441	4,105	3,336
Jan.	7,580	4,525	3,055
Feb.	5,273	3,580	1,693
Mar.	5,950	3,805	2,145
Apr.	6,281	3,909	2,372
May	10,099	6,727	3,372
June	10,203	8,091	2,112
Totals	104,052	67,399	36,653

Note:
(1) Penitencia and Rinconada water treatment plants sell water to Cities of Cupertino, Santa Clara, and Sunnyvale; also to California Water Service Company and San Jose Water Works.

Table II-26

UNADJUSTED RESIDENTIAL WATER DEMANDS,(1) SANTA CLARA COUNTY

(Environmental Science Associates, 1974)

Planning Area(3)	Residential Water Demand (mgd)(2)			
	1975	1980	1985	2000
San Jose	33.4	39.7	39.7	39.7
Evergreen	9.3	16.7	22.5	26.8
Alum Rock	9.7	13.6	16.9	16.9
Berryessa	3.4	7.4	10.7	14.7
Milpitas	5.7	7.8	9.6	14.4
Alviso	1.2	2.8	4.3	6.3
Agnew	2.4	2.4	2.4	2.4
Santa Clara	11.3	13.0	14.4	15.5
Campbell	13.5	14.5	14.5	14.5
Los Gatos	9.1	12.1	14.6	15.1
Saratoga	6.1	7.1	8.0	10.4
Cupertino	15.0	18.7	21.9	21.9
Sunnyvale	9.5	12.2	14.9	14.9
Mountain View-Los Altos	12.4	13.6	13.6	13.6
Palo Alto	9.9	10.0	10.0	10.0
Los Altos Hills	3.8	4.4	4.9	4.9
Lexington	1.1	2.1	3.0	3.0
Almaden	3.6	6.4	8.6	10.8
Edenvale	7.8	18.9	27.4	27.4
North County	168.2	223.4	261.9	283.2
Coyote	0.5	0.8	0.9	4.7
Llagas-Uvas	0.4	0.7	0.9	1.6
Morgan Hill	1.8	4.1	5.5	8.5
San Martin	0.7	1.1	1.4	2.4
Gilroy	2.5	5.5	7.7	8.9
Diablo Range	0.1	0.3	0.4	0.6
South County	6.0	12.5	16.8	26.7
Total County	174.2	235.9	278.7	309.9

Notes:

(1) Demand is stated in mgd (million gallons per day). In the following tables demand is presented in acre-feet/year: 1 mgd equals 1,121 acre-feet/year. The table is without projected increase in per-capita demand.

(2) The reader should note that the table contains projections from a draft report. The population data used as a basis for these projections of water use are considered by some to be high.

(3) Planning areas of Santa Clara County Planning Department: North County includes planning areas from the north boundary of county south through the Almaden, Edenvale, and Lexington planning area; South County includes planning areas from the north county area to south boundary of county.

Table II-27

PROJECTED TOTAL WATER DEMAND,(1)
SANTA CLARA COUNTY
(Environmental Science Associates, 1974)

Area	Water Demand (1000's of acre-ft/yr)(2)			
	1975	1980	1985	2000
North County				
Residential	190.3	255.2	302.2	336.2
Commercial and Industrial	54.5	67.8	77.8	105.9
Agricultural	49.5	22.6	3.0	2.3
Subtotal	294.3	345.6	383.0	444.4
South County				
Residential	6.8	14.3	19.4	31.7
Commercial and Industrial	1.3	2.2	3.3	6.4
Agricultural	60.2	52.5	47.7	31.9
Subtotal	68.3	69.0	70.4	70.0
Santa Clara County				
Residential	197.1	269.5	321.6	367.9
Commercial and Industrial	55.8	70.0	81.1	112.3
Agricultural	109.7	75.1	50.7	34.2
Total	362.6	414.6	453.4	514.4

Notes:

(1) These are the projections used for the analyses in the draft EIR prepared by Environmental Science Associates on San Felipe Project.

(2) The reader should note that the table contains projections from a draft report.

Table II-28

PROJECTED TOTAL WATER DEMAND,(1)
SANTA CLARA COUNTY
(Santa Clara Valley Water District in Environmental Science Associates, 1974)

Demand	Water Demand (1000's of acre-ft/yr)(2)		
	1980	1990	2000
North County			
Municipal and Industrial(3)	290.3	345.8	379.6
Agricultural	18.5	9.9	8.5
Subtotal	308.8	355.7	388.1
South County			
Municipal and Industrial	12.2	20.1	29.0
Agricultural	85.2	94.3	88.3
Subtotal	97.4	114.4	117.3
Santa Clara County			
Municipal and Industrial	302.5	365.9	408.6
Agricultural	103.7	104.2	96.8
Total	406.2	470.1	505.4

Notes:

(1) Note that these projections are not used for the analyses in the draft EIR prepared by SCVWD on San Felipe.

(2) The reader should note that the table contains projections from a draft report.

(3) Includes residential, commercial, and industrial categories.

Table II-29

TDS CONCENTRATIONS OF MAJOR WATER IMPORT SOURCES, SANTA CLARA COUNTY
(Environmental Science Associates, 1974)

Source	TDS
Hetch Hetchy	50 mg/1
South Bay Aqueduct	400 mg/1 (1970-1980)

Table II-30

SUMMARY OF GROUNDWATER QUALITY IN SANTA CLARA VALLEY — SOUTH BAY AREA
(SWRCB and RWQCB, 1974)

	High	Median	Low
TDS (mg/1)	1,750	336	226
Chlorides (mg/1)	698	25	6
Sulfates (mg/1)	162	45	8.6
Total hardness (mg/1)	778	242	96
Boron (mg/1)	2.4	0.1	0
Sodium (%)	59	22	12

Table II-31

COYOTE AND UVAS CREEK WATER QUALITY 1952-1967
(Environmental Science Associates, 1974)

Parameter	Maximum		Minimum	
	Coyote	Uvas	Coyote	Uvas
Specific conductance (micromhos at 25°C)	675	466	227	183
Temperature (°F)	72	80	48	45
Dissolved oxygen (ppm)	16.0	13.2	8.1	5.6
Percent saturation	154	126	76	60
pH	8.9	8.3	7.0	7.0
Mineral constituents (ppm)				
Calcium (Ca)	57	52	24	13
Magneseium (Mg)	26	42	10	10
Sodium (Na)	25	41	10	5.6
Potassium (K)	12	3.7	0.8	0.6
Carbonate (CO_3)	18	16	0	0
Bicarbonate (HCO_3)	340	239	105	95
Sulfate (SO_4)	49	44	20	9.6
Chloride (Cl)	25	14	5.5	3.2
Nitrate (NO_3)	4.4	1.6	0.5	0
Fluoride (F)	0.5	0.3	0	0
Boron (B)	0.29	0.27	0	0
Silica (SiO_2)	16	26	4.5	12
Total dissolved solids (ppm)	394	287	133	113
Percent sodium	21	32	12	9
Hardness as $CaCO_3$ (ppm)				
Total	322	227	90	82
Noncarbonate	76	34	0	0
Turbidity	330	140	0	0
Coliform (most probable number per ml)	>7,000	>7,000	<0.045	<0.045
Radioactivity in micro-micro curies per liter				
Dissolved alpha	0.62	0.90	0.00	0.00
Solid alpha	8.16	0.50	0.00	0.00
Dissolved beta	17.44	6.40	0.00	0.00
Solid beta	11.46	15.5	0.00	0.00

Section III

ENVIRONMENTAL IMPACTS

III.1

ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE

This section contains an analysis of potential environmental impacts that might result from implementation of the Basin Plan Alternative; optional alignments are addressed in Section IV.2.1. The Basin Plan Alternative would provide for the construction of a 16-mile long joint outfall pipe to transport wastewaters from the San Jose/Santa Clara, Sunnyvale, and Palo Alto wastewater treatment plants to a location approximately one mile north of the Dumbarton Bridge. At this location, the effluent would be discharged to San Francisco Bay through a submerged outfall diffuser. Potential impacts resulting from construction, operation, and maintenance, accidents, and natural catastrophes are discussed as they relate to all aspects of the physical, biological, social and cultural environments as described in Section II.

III.1.1 CONSTRUCTION IMPACTS

Since the Basin Plan Alternative has not been planned in detail and since the exact alignment may vary somewhat upon final design, construction impacts are discussed on a conceptual, or best estimate, level. Refinement of discussions based on equipment to be used, the numbers of workmen, and the time required to complete an activity in any one location may be made upon final design.

Physical Environment

Construction of the Basin Plan Alternative will have potential impacts on local topography, air quality, water and sediment quality, and noise levels. These impacts will be temporary and relatively minor. It is anticipated that construction will have no effects on geology, seismicity, groundwater, meteorology, or hydrology.

Topography. Surface erosion will be the principal short-term potential impact on topography along the Basin Plan Alternative right-of-way and at the pumping station sites, storage and staging areas, and any temporary access route. Long-term preemption of land surface (about 0.9 acre) will be an additional impact at the three pumping station sites, but not along the right-of-way (see Section III.1.2, Study Assumptions and Methodology).

Local surface relief along the Basin Plan Alternative alignment will be temporarily altered by trenching, operation of heavy equipment, and other construction activities within the right-of-way. Surface disturbance will vary from a 50-foot-wide easement in dry areas and in sensitive locations to a 150-foot-wide easement in mud flats and other "wet" locations. These activities will result in potential drainage and erosion problems: removal of vegetation and subsequent earth-moving activities will increase soil instability and erosion potential in both the excavated areas and temporary spoil piles. Although the alluvial soils are easily eroded, the flat topography along the pipeline right-of-way will tend to minimize this impact. A total of 411,000 cubic yards of spoil from ditching operations will be removed and disposed of at a suitable landfill, approved by the Regional Water Quality Control Board. Excavation at the pumping station site will require removal and disposal of spoil. Lesser disturbances will occur along temporary access roads due to routing of men and materials to and from the construction areas.

The pipeline corridor, storage areas, and access routes will be returned as closely as practicable to original condition at the completion of construction (Section III.3). Restoration procedures will include (revegetation of disturbed marshlands, resurfacing disturbed roadways, and stabilization of land surfaces. Long-term changes in terrain will be restricted to the sites of the three pumping stations, where small acreages (approximately 0.3 acre at each station) will be preempted.

Air Quality. During construction of the Basin Plan Alternative, there will be several short-term, localized impacts on air quality. Impacts will result from engine exhaust emissions, generation of fugitive dust, and possible release of naturally occurring hydrogen sulfide and methane gases from anaerobic sediments. All of these impacts will be temporary and minor.

During construction, emissions to the atmosphere will occur from construction vehicles and from private automobiles of construction workers. These emissions, primarily hydrocarbons, nitrogen oxides, and carbon monoxide, will occur in the vicinity of the construction areas as the work force arrives in the morning and departs in the evening and along the pipeline right-of-way during the working day as trenchers, bulldozers, backhoes, pipelaying equipment, and haul trucks move about in the work area. These vehicular emissions will generally be produced at a rate of about 60 grams of carbon monoxide, 7 to 10 grams of hydrocarbons, and 5 grams of nitrogen oxides per automobile-mile, and at a rate of 100 to 600 grams of carbon monoxide, 50 to 200 grams of hydrocarbons, 500 to 3,000 grams of nitrogen oxides, and 50 to 200 grams of particulates per construction vehicle operating hour. The variability in emissions is a function of construction vehicle size, horsepower, and task. The emissions from vehicles will be temporary (lasting only during construction) and localized, and are not considered to be significant. There are no viable alternatives or mitigating measures to abate vehicular emissions during construction activities.

The entire pipeline alignment is in low-lying land, where the water table is close to the surface. Nevertheless, it is possible that soil surfaces will dry and that the continuous passage of construction traffic during working hours will cause fugitive dust. In addition, parking areas for workers' private vehicles may also be a source of fugitive dust. Although these effects are expected to be temporary and localized, dust abatement measures will be used to control fugitive dust emissions. These measures will include paving, gravelling, oiling, or wetting vehicular parking areas, wetting construction roadways and areas to be graded or excavated as required, and the timely removal of load spills and wheel mud from local public roadways (see Section III.3).

The excavation of a trench through tidal wetlands may cause the release of quantities of hydrogen sulfide and methane gases, products of anaerobic decomposition of organic materials. Compounds such as mercaptans may also be present and released, but other major products of decomposition (ammonia and carbon dioxide) are water soluble and would not be released to the atmosphere. Hydrogen sulfide and mercaptans are highly odorous compounds. These odors may be detectable in nearby populated areas, depending on prevailing wind speed and direction and the locale of the excavation, but the quantities in nearly all areas, while odorous, will be at low levels and not toxic. Care will be exercised at the construction site to protect workers from potentially harmful doses of these gases, particularly within the pipeline trench itself. These conditions will occur during construction and will therefore be temporary and intermittent.

Water Quality. During construction of the terrestrial portion of the pipeline, potential impacts on water quality include increases in turbidity, nutrients, and chemical pollutants in water at stream crossings and in adjacent aquatic and wetland habitats. In the estuarine portion of the alignment, dredging will cause potentially sharp increases in concentrations of suspended solids, turbidity, oxygen demand, and chemical pollutants in the shallow Bay water. All construction impacts should be short-term.

About 78 percent of the Basin Plan pipeline alignment is on land (see Table III-2); the remaining portion will pass through shallow Bay water and will require dredging. Water quality will be affected to different degrees along these two portions of the right-of-way. Water quality in the various waterways and wetlands adjacent to the terrestrial portion of the alignment, such as the Guadalupe River or Stevens Creek, will be affected by construction activities that increase soil instability and particle transport in surface runoff. Turbidity, nutrient, and pollutant levels will increase in waterways. Erosion impacts will be minimal, however, due to the flat topography and should only occur at stream banks and crossings where water flows year-round.

Because of the high water table in marsh areas, some trench dewatering may be necessary. This water may be turbid and may degrade water quality locally when discharged to streams. Since construction activity is relatively short-term, turbidity increase in any one stream as a result of trench dewatering, is only expected to occur for one to two weeks. Trenching in wet areas will be limited to dry seasons of the year, further reducing the amount of dewatering necessary.

Such changes in the quality of surface water would have the most severe impacts on waterways where existing water quality is good or where the environment is particularly sensitive, such as in the Baylands Reserve. Impacts will be potentially most damaging at stream crossings. By scheduling work in the drier months of the year, impacts on water quality will be minimized, although not completely eliminated (see Section III.3).

Dredging in the estuarine portion of the right-of-way will cause temporary local alterations in Bay water quality. Since hydraulic dredging would cause high turbidity, a mechanical bucket-type of dredging is planned. The dredge will scoop out portions of the bottom mud to the proper depth. As each bucket of sediment is lifted, finer particles of Bay Mud will wash out of the dredge bucket, forming a turbidity plume in the water. The magnitude of the turbidity is in part a function of the nature of the sediment and the clarity of the ambient water. Sand and gravel bottoms cause little turbidity, while clay and organic muds create a great deal. The high proportion of fine particles in the soft Bay Mud will generate a dense turbidity plume. Turbidity plumes from dredging are generally relatively small in extent and brief in duration, lasting less than a day after cessation of dredging (Lee and Plumb, 1974).

The main deleterious effect of turbidity on water quality is a decrease in light penetration through the water column, which can reduce the photosynthetic rate of aquatic plants. In most cases, however, the reduction of light penetration is a short-lived phenomenon and can be expected to have only a temporary effect on water quality near the dredging site. Furthermore, the existing turbidity levels in the South Bay are normally quite high (Section II.1.1) and will partially mask the turbidity increases during dredging.

Other effects of dredging on water quality are less direct. Sediments contain interstitial water filling the voids between the solid particles. This water contains no dissolved oxygen and, as a result, normally contains rather high concentrations of phosphates and heavy metals (such as iron, lead, zinc, mercury, and copper). These levels are usually much greater than those found in the oxygenated overlying water. When interstitial water is mixed into the overlying water column during dredging, the concentrations of these chemicals in the Bay water will temporarily increase. Dissolved oxygen in the overlying water column will rapidly react with the chemically reduced materials in the suspended sediment-water mixture, causing phosphates and metals to reassociate with the suspended solids in the turbidity plume. These chemicals will be carried back to the bottom as the silt settles out. The heavy ambient silt load of the South Bay water will enhance this process. Over the short-term, however, water quality with regard to particulates, phosphates, and heavy metals will be altered, and a measurable oxygen demand will be exerted. In addition, oils and grease, pesticides, and other organic compounds associated with the finer sediment particles will mix into the water. Potentially toxic materials associated with anaerobic conditions, such as sulfides and ammonia, may also be released from the disturbed sediment. All of these problems are temporary, however, and when the turbidity plume settles, the water quality will return to its ambient state (Windom, 1972; Lee and Plumb, 1974).

Sediment Quality. Although the trench will be dredged for about four miles in the South Bay sediment (Stations 60 through 82, Figure I-2), only minor impacts on sediment quality will occur. After the pipeline is emplaced, the trench will be backfilled with clean, coarse-grained fill (approximately 654,000 cubic yards) imported from a Bay Area quarry. The placement of clean fill will change the bottom characteristics along the pipeline alignment temporarily. As years pass, suspended solids will continue to be carried into the South Bay and be deposited. As silting continues, the clean backfill will gradually be covered with a fresh layer of Bay Mud, and the new bottom surface along the alignment will take on the characteristics of the old.

Dredging will also tend to redistribute some of the finer sediment material that washes out of the dredge at the site. This material will resettle in both the dredged and undredged areas, but will have little immediate impact on the sediment quality of the area.

The dredged spoil will be disposed of at the approved (Corps of Engineers, RWQCB) Alcatraz disposal site in San Francisco Bay. A turbidity plume will be generated by spoil dumping at the disposal site. The finer material in the spoil will be partially dispersed throughout the Central Bay by tides and currents. At ebb tide some spoil may be transported out of the Bay to the Pacific Ocean. The suspended spoil fines will be indistinguishable physically from the large volume of suspended solids transported into the Bay by the Sacramento River, although the deposited spoil will differ chemically from the natural sediments near Alcatraz (i.e., the spoils are more polluted).

Noise. Cranes, bulldozers, front-end loaders, backhoes, and compressors are expected to be the most significant sources of noise during construction on land. These pieces of equipment typically generate noise levels in the range of 75 to 90 dBA* measured from 50 feet (EPA, 1971). Under worst conditions, i.e. when all pertinent equipment is present and operating at the site, the L_{eq}* at 50 feet is estimated to be 89 dBA (EPA, 1971). No blasting or rock drilling is expected.

During construction in the estuarine portion of the alignment, pile driving is anticipated. Pile driving may also be required during construction of the pumping stations and will be the major source of noise. Pile driving generates peak noise levels ranging from 96 to 106 dBA measured 50 feet from the source, depending on the type of piles and the pile driver used (Rosenberg and Slater, 1971). The predicted noise levels at various distances from the construction site due to land construction activity and pile driving using the above peak noise levels are presented in Table III-1. These noise levels may be reduced to some extent by "quiet" equipment (Section III.2).

Table III-1

PREDICTED MAXIMUM NOISE LEVELS FROM CONSTRUCTION EQUIPMENT AND PILE DRIVING ACTIVITIES

Distance from Noise Source (ft)	Construction Activity[1]		Pile Driving Maximum Noise Level (dBA)
	Maximum Noise Level (dBA)	L_{eq}(dBA)	
50	95	89	106
100	89	83	100
200	83	77	94
400	77	71	88
800	71	65	82
1,600	65	59	76
3,200	59	53	70
6,400	53	47	64
12,800	47	41	58

Note:
(1) Assuming three pieces of identical equipment, each generating 90 dBA at 50 feet.

Existing local and federal noise criteria are presented in Appendix F. Construction noise impacts can be assessed by comparing ambient noise levels with the predicted construction noise levels and the appropriate noise criteria. Comparing existing noise levels of 57 to 65 dBA (Section II.1.1, Noise) with EPA criteria of 55 dBA (Appendix F) indicates that the existing noise levels adjacent to the proposed pipeline route already exceed the level recommended for protection of public health and welfare. Construction noise, especially pile driving, will temporarily increase these ambient levels. Since construction at a given location will take place over a limited time period, it is anticipated that the construction noise will not significantly alter the existing noise environment in the area.

When the construction takes place within the city limits of Sunnyvale, the noise levels within 6,500 feet of the construction activities may exceed 50 dBA, the maximum desirable noise level specified by the City Code (1969) at a property line in a residential district. Similarly, when construction takes place in Mountain View or Palo Alto, the noise levels may exceed 65 to 86 dBA, the maximum desirable sound levels for the boundaries of industrial areas or at the property line of a project, respectively (City of Mountain View, 1973; City of Palo Alto, 1972). In addition, the noise levels produced both on land and estuarine sections may exceed the existing local ambient noise levels by more than the amount specified by the Palo Alto municipal code (see Appendix F). These city codes do not provide specific penalties for violations of these specified noise levels. During consideration of granting construction permits, these projected violations will be taken under advisement; permits may be denied on this basis, or a variance may be granted (generally, construction noise is considered exempt from noise codes) provided all practical mitigation measures are implemented (Section III.3).

Biological Environment

The construction of the Basin Plan Alternative would disturb a number of biologically productive areas. The construction of the trench will result in the removal, destruction, or displacement of any flora or fauna within the construction easement and in the equipment and materials storage and laydown areas. The width of the easement, which can generally be equated to an "impact zone," would be 150 feet or less. In constricted locations and in sensitive terrestrial habitats, the width

---

*dBA — the A weighted noise level is a unit of sound measurement electronically determined to approximate human hearing sensitivity (see Table II-8). L_{eq} — the equivalent, or "average," sound level in dBA. See also L_{90} — noise level exceeded 90% of the time.

of the construction easement could be narrowed to approximately 60 feet. In soft mud substrates, the increased potential for collapse of the trench walls may require the excavation of a trench approximately 80 feet wide at the top in marshy areas and 100 feet wide at the top in mud flats and open water localities.

The magnitude of construction impact resulting from the loss of plants and animals varies with the quality and importance of the habitat being crossed. In the South Bay, the "salt marsh" habitat is the most sensitive biologically, because of its increasing scarcity, high biological productivity, and the number of endangered species residing there. The relative importance of other habitats affected by construction is less. In general, the habitats can be ranked in decreasing order of sensitivity as follows:

(1) Salt marsh
(2) Mud flats
(3) Salt pond dikes
(4) Grassland
(5) Open water

Some of the areas to be crossed by the Basin Plan Alternative have been so extensively developed or modified from their natural state that they have little or no value to wildlife. These include paved areas, active agricultural fields, landfills, and similar urban habitats. Other habitats discussed in Section II (fresh and brackish water streams and marshes; salt ponds) will not be affected by construction.

The 16-mile alignment would directly affect the five habitat types listed above (see also Figure II-14). An analysis and tabulation of the length of the Basin Plan Alternative within each habitat in each of the three segments of the project, as determined by measurements from Figure II-14, are presented in Table III-2. Stream and slough crossings were not included in this breakdown. It can be seen that about 26 percent of the route passes through highly developed or biologically unproductive areas; the remaining 74 percent crosses areas with some biological sensitivity. In the following discussions, the construction impacts on biota for each of the three alignment segments will be reported.

Segment I - San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant. The most sensitive area in this segment is the Alviso salt marsh (Station 7). The removal of pickleweed and other salt marsh vegetation in this area can be limited to a practical width of 60 feet, resulting in a net destruction of approximately 1 acre or about 3 to 4 percent of the remaining marsh.

It is possible that a salt marsh harvest mouse population in the marsh would be adversely affected, although none was identified in the summer trapping survey (see Appendix I). The use of the area by raptors (birds of prey such as hawks, falcons, owls) will be reduced during construction, and the population sizes of other prey species may be depressed somewhat until the marsh is restored (see Section III.3). The majority of the rodents in the marsh are house mice, which presumably enter the area from the adjacent landfill.

The marsh remnant on the east side of Eldorado Street (Station 6) is isolated from water. Wildlife use of the area, as observed during 1975, was very low. Impacts will be minimal. The other area of salt marsh in this segment is the seasonally dry field west of Saratoga Creek (Station 9). The salt marsh harvest mouse was not detected in the area during summer trapping (see Appendix I). As with the marsh segment at Station 6, the wildlife activity was very low.

The grassland portions of the segment are all pasture lands for horse grazing or abandoned fields or orchards. In the alignment, the plant community consists almost entirely of wild oats (*Avena* sp.) which revegetates easily. Wildlife activity observed in these grasslands was low. The death of some small rodents within burrows in the construction easement is unavoidable. No endangered or rare rodents are known from the South Bay grasslands. Other animals may be displaced, resulting in crowding and increased intraspecific

Table III-2

BIOLOGICAL HABITATS IN OR ADJACENT TO THE PROPOSED PLAN ALTERNATIVE

		Approximate Distance in Each Habitat Type								
		Relatively Natural Productive Habitats					Highly Developed Areas			
	Unit	Salt Marsh	Mud Flats	Salt Pond Dikes	Grassland	Open Water	Salt Pond Abandoned	Agricultural Land	Landfill Dikes	Roads, landfills, airports, etc.
Segment I — San Jose/Santa Clara to Sunnyvale — Stations 0 to 19.5	ft	2,500			12,500			4,500		1,000
	mi	0.47			2.37			0.85		0.19
Segment II — Sunnyvale to Palo Alto — Stations 19.5 to 56	ft	3,000		12,750	7,750		2,750	2,000	6,250	2,000
	mi	0.57		2.41	1.47		0.52	0.38	1.18	0.38
Segment III — Palo Alto to Discharge Point — Stations 56 to 82	ft	1,250	4,000			18,000				2,750(1)
	mi	0.24	0.76			3.41				0.52
Total Distance	ft	6,750	4,000	12,570	19,250	18,000	2,750	6,500	6,250	11,500
	mi	1.28	0.76	2.41	4.26	3.41	0.52	1.23	1.18	1.09
Percentage of Total Distance		8.0	5.0	15.5	23.5	22.0	3.5	8.0	7.5	7.0

Note: (1) Includes effluent sewage pond adjacent to the south end of the Palo Alto Municipal Airport runway.

competition in surrounding areas. Displaced individuals are also more susceptible to predation. These factors generally result in increased mortality rates for those affected species, whether bird or mammal.

The alignment would cross the toe of a landfill next to Highway 237 at Station 8, an area which is bare ground at present. No significant impact on biota is likely. Similarly, the route crosses through the edge of agricultural fields from Station 15 to the Sunnyvale pumping station site. Construction in these fields will have minimal impact on the biota of this heavily developed area. The tie-in line from the Sunnyvale treatment plant to the pumping station would be placed between a landfill and an access road.

The primary adverse biological effect of the stream crossings will be the removal of marsh vegetation growing in the narrow intertidal zone on the banks. The removal of a 100-foot-wide section of cattails and bulrushes from both sides of each stream will reduce the cover for riparian birds and mammals. Other impacts will result from the disturbance of bottom sediments, including removal of stream benthos, increases in turbidity in the stream, and downstream siltation as a result of increased turbidity. The quality of the habitats in Guadalupe, Saratoga, and Calabazas Creeks and the unnamed creek is reduced as a result of past channelization activities; the loss of benthic organisms during trenching both from direct removal and siltation will be minor. These impacts will be mitigated by construction using temporary cofferdams and diverted flows, as well as by scheduling construction during summer low flow periods. The stream banks and channel will be restored, as much as practicable, to near-original condition. The net adverse impact of crossing these streams is not expected to be significant.

Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant. Segment II, the longest of the three segments, would pass through several highly sensitive areas. Construction through the Palo Alto Baylands Reserve and the in-dike passage between Stations 29 and 36 may have significant short-term effects.

The route across the Baylands Reserve would lie immediately west of the buried sewage conveyance pipeline from Mountain View to the Palo Alto treatment plant. When that pipeline was constructed, the excess trench spoils were left in place on the west side of the centerline. The spoils pile, approximately 2 feet high, has become overgrown with annual weeds typical of a dry, grassland habitat. The immediately surrounding habitat is patchy pickleweed. Each summer, the pickleweed flats dry out and begin to support a fauna more typical of the grasslands that are interspersed with the pickleweed plots throughout the Baylands Reserve. Trenching for the SBDA pipeline would entail removing some grassland and some pickleweed marsh vegetation. The area will undergo a disturbance quite similar to that when the previous pipeline was built, although excess spoils will be removed. Habitat damage could adversely affect the salt marsh harvest mouse, Alameda song sparrow, and other resident species in the upper Baylands Reserve. The construction schedule would be planned to avoid the breeding periods for these species (April through mid-June). Construction noise could displace sensitive wildlife from a broad band on either side of the easement, including the freshwater pond just west of Station 50. Based on the apparent recovery of the area following construction of the previous pipeline, it is unlikely that irreversible damage to the Baylands Reserve habitats or biota will occur. By the time of construction, the project could be planned to achieve maximum compatibility with development goals of the City of Palo Alto Department of Nature and Science and the City of Palo Alto Planning Commission.

The crossing of Mayfield Slough within the Baylands Reserve (Station 48.5) will require similarly detailed planning and scheduling to minimize impacts and to restore the stream banks to near-original condition (Section III.3). The crossing would require the clearing of approximately a 100-foot-wide strip of marsh vegetation to achieve a suitable depth in the trench. Excess spoils would be disposed of in an approved manner; excess spoils from all land trenching would be suitable for use as landfill, for example.

A second sensitive area in Segment II is on and adjacent to the series of salt pond dikes between Stations 36 and 40. As presently envisioned, the trench would be excavated into the southerly side of the levee, with access provided by the levee. The trench spoils would be temporarily piled off to the side to enlarge the levee, intruding into the upland saline ponds present on both sides of Stevens Creek. No disturbance of salt ponds A-2E and A-2W would occur.

Both of the upland saline ponds have high wildlife values. The westerly pond is heavily used by waterfowl and shorebirds for resting and feeding at all seasons of the year. The easterly pond, much of which has been covered by the Mountain View landfill, was reported by Gill (1973) to be a significant waterfowl nesting area. He observed nesting on the dike banks and in the higher areas of pickleweed. Construction activities, as described above, would eliminate the on-dike nesting of waterfowl until a cover of weeds and emergent vegetation is reestablished through revegetation programs and natural succession (Section III.3). Construction would be scheduled to avoid the peak nesting period (April-June) of the bird species of the area. During construction, equipment noise could discourage waterbirds and upland birds, such as the white-tailed kite, from utilizing the saline ponds, dikes, and the salt ponds for feeding and resting. Because of the high ambient noise levels around Moffett Field and the Ames Research Center, the wildlife in the area may be much more tolerant of noise than similar organisms in the Artesian Slough area might be.

Spoils piling would temporarily reduce the surface area of the upland saline ponds and would increase the turbidity for a few days. The width of the dike would be expanded approximately 15 feet in its final, permanent configuration, decreasing the area of the saline ponds and increasing the amount of dike surface area available for use by wildlife. Excess spoils would be disposed of in a suitable landfill. When fully recovered this habitat would again be available to nesting waterfowl and rodents.

Another section of this portion of the alignment to be placed in or adjacent to a salt pond dike would be at the edge of the Moffett Field Golf Course, Bay access channel, and landfill (Stations 22 to 24). The latter two localities are near the end of the airfield runway in an area of high noise impact. Biological values are low in this section, and construction impacts are not expected to be significant.

Segment II would cross grasslands between Stations 21.5 and 26 and Stations 51.5 and 55. Both of these sections pass near developments; the former is next to the Sunnyvale landfill and the Lockheed complex at Moffett Field, and the latter is next to existing and proposed areas of the Palo Alto landfill. As was noted earlier, grassland habitats are quite resilient and revegetate easily. The loss of habitat in the construction easement and the disturbance or displacement of wildlife due to noise and dust are expected to be minor and readily reversible impacts. In the Baylands Reserve area, burrowing owls, which reside in abandoned ground squirrel burrows, may occur in the easement. These birds have been observed in the vicinity although their presence in the proposed alignment has not been confirmed. These and other animals displaced during construction may be lost because their habitats in adjacent areas are probably filled to carrying capacity.

The remaining sections of Segment II would cross developed habitats with low value to wildlife. The impacts of construction in the agricultural field between Stations 19.5 and 21 will be the same as those discussed for the adjoining upstream section.

From Stations 40 to 46, the Basin Plan Alternative would be placed in the broad landfill dike located inboard of the A-1 and A-2W salt pond dikes. This 30-foot-wide dike protects the Mountain View Regional Shoreline Park and has little or no wildlife value. No direct impacts are expected. The noise of construction equipment may disturb waterbirds on the salt ponds, but this effect should be minor. Large earth moving equipment with similar noise producing characteristics has been in operation in these landfills for a number of years.

From Station 46.5 to 48, the Basin Plan Alternative would be placed in or adjacent to Terminal Boulevard and would cross the abandoned Mountain View treatment plant grounds. Except for the possible disturbance of wildlife by construction noise, little or no biological impact should occur. From Stations 55 to 56, where the Palo Alto pumping station would be installed, the route would be on the grounds of the Palo Alto treatment plant, a section with minimal biological value.

The slough and creek crossings in this segment would be similar in scope and impact to those in Segment I. Stevens Creek and Mountain View Slough in the vicinity of the crossings receive low use by wildlife and do not appear to be sensitive aquatic systems. Mayfield Slough, in the Palo Alto Baylands Reserve, was discussed above. The other isolated arm of Mayfield Slough near Station 52 is a dry depression during the summer and fall and contains little or no aquatic vegetation even when filled with water. With construction scheduled for the summer months, when the slough bed is functionally a low-productivity grassland, impacts should be similar to those expected for the adjoining grassland construction.

Segment III — Palo Alto Treatment Plant to Discharge Point. Sensitive habitats in this segment include the Palo Alto salt marsh and offshore mud flats and portions of the airport grasslands. The habitats in this segment are remarkable for the variety and abundance of wildlife present in such a developed area.

The Basin Plan Alternative would be placed in the bottom of the existing sewage channel after it has been redredged to a depth of approximately 18 feet. Because of softness and collapsibility of the Bay Muds, it is expected that the final width of the trench might be as much as 80 feet at the surface. This would result in the removal of a 20- to 30-foot-wide band of salt marsh vegetation on either side of the 30- to 50-foot-wide channel.

The dominant plant species in this portion of the marsh are saltbush and cordgrass. Removal of this vegetation will temporarily reduce the habitat available for species such as the California clapper rail, the salt marsh harvest mouse, and the Alameda song sparrow. Use of the channel by waterfowl will also be curtailed. Careful scheduling of construction (avoiding mid-May through June, the peak nesting period of the clapper rail) and the revegetation of the marsh and restoration of the existing channel bottom contour (Section III.3) will be especially important in this sensitive area.

Another portion of this segment would cross the Palo Alto Municipal Airport. Depending on the final alignment through the airport grounds, the biological impacts of construction may be insignificant to moderate. Burrowing owls are common in the area, both in the unpaved spaces and the dikes. Where the alignment intersects these two subhabitats, displacement of burrowing owls will occur. Another biologically sensitive area on the airport grounds is a small "pond" to the east side of the south end of the runway. This pond formed about six years ago when a leak developed in an abandoned arm of the Palo Alto treatment plant effluent pipeline. The water in this pond is the same as that presently being discharged into the sewage channel. The presence of water at the surface has encouraged the growth of weeds and has developed into a microhabitat utilized by black-necked stilts, killdeers, and other occasional visitors for resting and cover. These birds occupy the pond even in the presence of landing and departing light aircraft less than 50 feet away. As presently proposed, the easement would encompass essentially all of the pond. The old pipe would be removed during construction, and the pond would not be restored. There is alternative habitat available to these wading birds; however, it is expected that a minor net adverse impact will occur with the loss of this pond. The number of birds displaced will be small, and the impact is expected to be similarly small.

From Stations 60 to 62, the Basin Plan Alternative would cross the tidal mud flats between the Palo Alto salt marsh and Mayfield Slough. The most significant impact to occur within the mud flats will result from the direct removal or displacement of sediments from the alignment. Most of the epifauna (organisms within the water-sediment interface) will be removed during the dredging operation. The infauna (organims living in the sediments) do not have the capability of moving out of the pipeline alignment, and as a result, will also be removed from the mud flat. Organisms from both habitats, such as polychaete worms *(Streblospio benedicti, Asychis elongata)* and bivalve molluscs *(Modiolus senhausia)* will be permanently displaced from the pipeline alignment. Organisms capable of swimming, such as the amphipods *Ampelisca milleri* and *Microdeutopus schmitti*, will probably move away from the disturbed area and will not be significantly affected by the construction activities.

The magnitude of the impact of dredging is directly related to the geographical distribution and the seasonal fluctuations in the number of individuals within a population, as well as the overall biological productivity of the local mud flats. Associated with the changing biological characteristics within the mud flats, dredging impacts are indirectly related to the type of equipment used, the timing, and the duration of the dredging operation.

Analyses of the geographical distribution in the number of species within the mud flats are presented in Appendix H. These data on the ecology of the mud flats suggest that the organisms living on or in the mud flats are widely distributed throughout similar habitats in the Bay. Similarly, the number of individuals within a given population varies from season to season. This situation indicates that although the dredging operation will have a significant impact within the alignment, the overall biological productivity of the mud flats is not expected to be significantly reduced.

During the dredging operation, the finer fractions of the sediment will escape from the dredge bucket and create a turbidity plume (as discussed previously). Those organisms living within the interface between the sediment and water and adjacent to the dredged trench may be temporarily covered with the finer material as it settles to the bottom. The magnitude of this impact will for the most part be related to the type of organisms living within the immediate area of the turbidity plume. The larger nonmotile species, such as polychaetes *(Asychis elongata, Streblospio benedicti)* and molluscs *(Modiolus senhousia)*, will probably cease their feeding activity and remain temporarily inactive during the flood tide or retreat into the sediments until such time as they can effectively filter the supernatent water. These larger species live within a rapidly changing environment subject to daily variations in turbidity and water quality. Considering the short duration (1 to 2 days) of increased turbidity and the high number of organisms within the local mud flat habitat (see Appendix H), the impacts are expected to be minor and short-term.

As described previously in the section on water quality, (Section III.1.1), other potential changes in water quality as a result of dredging include decreases in dissolved oxygen levels locally, an increase in nutrient levels, and increases in the concentration of heavy metals. These changes in water quality could affect the biota in the vicinity of the dredging activity; no acute toxic effects or stimulation of algal blooms are anticipated. The ambient turbidity at the dredging site is sufficiently limiting to prevent algal blooms. As these materials reassociate with the suspended solids in the turbidity plume, the potential for acute toxicity will decrease. Long-term impacts are not anticipated, since pollutant levels in the sediments are not expected to increase as a result of dredging.

The long-term impacts within the mud flats will result from the permanent alteration of the sediment texture along the alignment. The size distribution of particles in the backfill material will probably be coarser than the existing silt and clay sediments of the mud flats. This newer material will provide a new habitat, subject to biological invasion and settlement by benthic forms capable of living within this type of substratum. A different benthic community from that of the surrounding mud flats will develop after natural succession has occurred. During this succession, the biological productivity within the alignment will be lower than the surrounding area because of the lower number of smaller organisms that now typify the Bay Mud sediments. This will affect the aquatic food chain; those species feeding on the benthos (wading birds, diving ducks, and some fish species) will experience a reduction in available food supply. The decrease of productivity will occur over an area of approximately 18 acres (8,000 feet of trench, approximately 100 feet wide at the surface), or about 0.1 percent of the mud flats in the South Bay (13,500 acres). This reduction, therefore, is not expected to have significant, long-term impacts on the productivity or the food chain of the South Bay. With time, the upper layers of the sediments within the easement will approach near-original condition as a result of natural sedimentation, and the biological community will also begin to resemble that of the nearby Bay Mud. The current natural sedimentation rate, which requires frequent maintenance dredging for the approach to the Palo Alto Yacht Harbor, will probably result in complete siltation over the construction area in about five years.

The open water habitat within the Basin Plan Alternative alignment would extend from Mayfield Slough to the disposal point (Stations 64 and 82). Analyses of the baseline samples indicate that the molluscs *Gemma gemma* and *Modiolus senhousia*, the oligochaete worm *Peloscolex apectinatus*, and the polychaete worm *Streblospio benedicti* are the dominant species in this area. The nature of the impacts to this estuarine benthic community will be similar in character to those described for the mud flats, but greater in extent because of the greater length of the alignment in the open water habitat (Figure II-2). However, the biological impacts from the dredging operations are expected to be less than those described for the mud flats, since the biological productivity of the open water habitat is less than on the mud flats.

The dredging impacts will primarily affect the benthic community. Fish in the vicinity should be able to avoid the area of dredging and the plume resulting from that activity. An exception may be anadromous fish such as steelhead trout. Dredging may interfere with the annual run of steelhead to San Francisquito Creek. In order to eliminate adverse effects on the steelhead population, dredging should be scheduled to avoid the migratory season.

The relatively minor and short-term impacts associated with the turbidity plume will be similar to those discussed for mud flats. Changes in the benthic community will occur within the open habitat as in the mud flats. However, a different mix of benthic species may settle in this portion of the backfill material due to the different environmental conditions existing within each habitat.

Social, Economic, and Cultural Environment

Construction activities related to the Basin Plan Alternative will have both direct and indirect impacts on the social, economic, and cultural resources of the study area. Impacts on population and demographic characteristics during the construction period are not anticipated. An analysis of the economic impacts associated with financing the capital costs of the project is presented in Section III.1.3.

Recreational Uses of the Area. Impacts on recreational areas during construction of the Basin Plan Alternative will be limited to temporary constraints on the access to public use areas, preserves, and parks along the project route. Specifically, access to the Mountain View Shoreline Park, Palo Alto Baylands Reserve, and the Palo Alto Yacht Harbor may be limited during construction activity in these areas. Additionally, dredging activity in the Mayfield Slough channel will impose temporary restrictions on navigation between the Palo Alto Yacht Harbor and the main channel in San Francisco Bay. Dredging equipment would be located in the Mayfield channel; however, adequate clearance to accommodate passage of small boats would be maintained during dredging activities in this area. Public access to areas currently used by duck hunters and birdwatchers outboard of the pipeline route may also be interrupted during construction in these areas.

Archaeological, Paleontological, and Historical Resources. Construction activities of the Basin Plan Alternative may uncover subsurface remains, as discussed earlier (Section II.1.3). Given the depth of the Qyfo and Qyf deposits (see Figure II-21), archaeological resources could be contained within the limits of the trenching activities and, if so, could be damaged or destroyed if not properly recovered (see Section III.3).

It is also likely that construction will encounter paleontological remains. Although the significance of these remains can be variously interpreted, it should be assumed that any remains encountered will contribute to the understanding of the geologic history and the paleoecological history of the San Francisco Bay Area.

The likelihood of encountering the fossil remains of large vertebrates is considered high and may result in considerable popular as well as scientific interest. Excavations into present sediments will afford geologists an opportunity, as occurred during excavations at the Mountain View sanitary landfill, to study the stratigraphy of the Bay margins and to collect fossil flora and fauna.

Impacts on historical resources will occur if construction activities encounter the remains of historic sites. As described in Section II.1.3 and Figure II-22, numerous historic landings might be encountered during the excavation.

Visual and Aesthetic Setting. Construction impacts on the visual and aesthetic setting of the area will be limited to the area along the alignment and spoils hauling route. The existence of construction equipment, temporary spoil piles along the right-of-way, spoils hauling vehicles, construction noise, and odors as a result of trenching will have a temporary, adverse impact upon the visual and aesthetic setting of the area. These impacts are expected to be limited due to the subgrade character of the Basin Plan Alternative and the method of working in a continuous manner — excavation, laying of the pipe, and backfilling along the right-of-way. Upon completion of a segment in one area along the route, the evidence of construction activity will be eliminated and the area will be restored, as practicable, to near-original condition. Measures recommended for this restoration include resurfacing of disturbed roads, cleanup and revegetation of disturbed lands, and grading or other activities to return topographical contours, stream banks, and dikes to near-original configuration (see Section III.3).

Economic Setting. The analysis of construction impacts on the economic setting of the study area has been developed for the construction phase of the Basin Plan Alternative. As such, both direct and indirect impacts associated with this phase are presented. As stated earlier, the economic impact analysis of financing of the capital costs of the project is discussed in Section III.1.3.

Direct impacts, for the purpose of this section, are the measurable influences of the project on the structure and performance of the local economy. The important economic factors included in this impact category are onsite employment and personal income.

Indirect impacts are the less quantifiable changes in the socioeconomic structure that, although related to the existence of the project, generally occur secondarily as a result of direct impacts. For example, the general level of business activity in the community could be stimulated by the construction employment and the resultant personal incomes that are spent for the goods and services available from local business firms.

The direct construction impacts on the existing social and economic setting of Santa Clara County are a function of three elements:

- Duration of construction period
- Total capital costs
- Construction employment

The total construction period of the Basin Plan Alternative is estimated to be approximately 24 months, and the total capital costs of the completed project are estimated to be $86.123 million in 1980. A portion of this would be paid out as wages to construction laborers. It has been estimated that an average work force of 190 would be employed during the two years of construction. Using an estimated average annual wage of $25,000 per contract construction employee in 1980* for the San Francisco-Oakland area and a work force of 190 employees, about $9.6 million would be paid as wages for construction. The total construction force of approximately 190 employees is 1 percent of the most recent level of construction employment in Santa Clara County.

It was assumed that a construction worker would expend his wages and salary (and other personal income) in a consumption pattern generally consistent with that for urban family budgets, as shown in Table III-3 for the San Francisco-Oakland area. On the basis of these consumption patterns, it is possible to estimate the likely distribution of project generated construction wages and salaries by broad sectors. It is not possible without a very detailed study, to determine the spatial distribution of these expenditures throughout the study area. However, it is possible that as much as 90 percent of the wages and salaries spent would stay within the immediate Santa Clara County economy.

When the construction workers spend their wages on goods and services in the community, a portion of this money will become part of the personal income of producers of consumer goods, merchants, and service industry employees. Thus, there will be a multiplicative expansion in the income stream greater than the amount of initial wage expenditure of about $9.6 million. Assuming that the construction workers tend to spend two-thirds of their incomes on new consumer goods and services (one-third goes for taxes, savings, and so forth), these workers will spend about $6.4 million on consumption items during the construction period.** These expenditures will, in part, become personal income for the individuals in the project area, who will also spend two-thirds of their income on goods and services. Because this process continues, a multiplier in the range of 2.0 to 2.8 can be used to calculate both the total employment and personal income generated. Projected indirect employment will thus be 456 (using a 2.4 multiplier). Projected equivalent annual personal income generated will be $23.0 million, of which about $13.4 million is indirect personal income.

Specific economic impacts on the agricultural industry along the proposed Basin Plan Alternative route will occur. Approximately 60 acres of the total 1,270 acres currently in agricultural use would be temporarily removed from production as a result of construction. The loss of this acreage along Caribbean Road during the growing season would amount to approximately 1,125 to 1,200 man-days, assuming an entire growing season was missed. Based on an average wage of $36 per day per farm laborer in 1980, the maximum loss in wages due to the project would be between $40,500 and $43,200 (U.C. Extension Services; personal communication, 1975).

The related loss in agricultural production is difficult to assess due to the wide variety of crops in the area. However, by averaging the gross values per acre of crops that have been observed in the area, an approximate production loss can be calculated. Assuming an average value per acre in production at $1,000, the loss of 60 acres during the growing season of all crops would place the maximum production loss at $60,000, giving a maximum impact on the agricultural industry of $103,200.

---

* Based on annual wages and salary in the construction industry in the San Francisco-Oakland Metropolitan Area of $15,680 in 1975 dollars for an estimated 40-week work year.

**Assuming a marginal propensity to consume of 0.67, with the remaining third going to taxes, savings, and import consumption.

Table III-3

ESTIMATED DISTRIBUTION OF CONSTRUCTION-RELATED WAGES AND SALARIES 1979-1981 IN 1975 DOLLARS

(Intermediate Family Budget)(1)
(U.S. Department of Labor, 1975)

Goods and Services	Wages and Salaries(5)		
	Annual Average per Worker ($1,000)	Total Project ($1,000)	Percent of Total
Food	5.8	2,237	23.3
Housing(2)	6.0	2,285	23.8
Transportation(3)	2.0	778	8.1
Clothing and Personal Care	2.0	749	7.8
Medical care	1.4	518	5.4
Other Family Consumption	1.3	509	5.3
Other Expenditures(4)	1.1	432	4.5
Social Security and Disability Insurance	1.4	547	5.7
Personal Income Taxes	3.4	1,325	13.8
Total Expenditures	24.4	9,370	97.7
Savings	0.58	221	2.3
Total Wages and Salaries	25.0	9,591	100.0

Notes:
(1) Consists of a family – husband employed, wife, and two children.
(2) Shelter, household operations, furnishings, and lodging away from home.
(3) All families assumed to be automobile owners.
(4) Include gifts, contributions, life insurance, occupational expense.
(5) Total wage bill generated by the project.

Construction activities, however, will not result in a loss of the use of these lands for an entire growing season; it is anticipated that only about two weeks of the growing season would be affected at most, and the above described monetary losses are greater than those anticipated for the area. Following the installation of the segment of the Basin Plan Alternative, original topsoil will be replaced, assuring an approximate restoration of the basic productivity of those lands devoted to agriculture.

Present Land-Use Patterns. The construction impact on present land-use patterns along the Basin Plan Alternative route will be temporary and limited to a small portion of the total lands within the study area. It is anticipated that no impact will occur on the mineral resources of the Baylands.

During construction, a variety of impacts on existing land uses are expected because of the diversity of land uses along the Basin Plan Alternative route. These temporary land-use impacts are related to:

- Disruption of agricultural land use
- Traffic disruption at several road crossings
- Interruption of access to several public use areas and preserves

Traffic disruption resulting from project construction activity can be expected at four major road crossings at San Jose-Alviso Road, twice at Caribbean Road, and at Embarcadero Road near the Palo Alto treatment plant (Figure I-2). Several other secondary road crossings (i.e., unpaved service roads or service roads within private property), where relatively low volume traffic occurs, can be expected to be disrupted during construction.

Temporary impacts can be expected to occur at the Palo Alto Municipal Airport along the northern edge of the facilities apron and at the eastern end of the runway.

Access to various preserves and open space areas during construction will also be disrupted. Specifically, access to the Mountain View park, the Palo Alto Baylands

Reserve, and the Palo Alto Yacht Harbor will be partially limited during construction activities in these areas. Additionally, the salt marsh north of the Palo Alto Municipal Airport will be temporarily inaccessible during construction in this area. This disruption will be short-term, lasting between one and two weeks during construction.

Projected Land-Use Patterns. The apparent impact associated with Basin Plan Alternative construction on projected land-use patterns is the restriction placed on further construction within the right-of-way. This area of restriction is a small amount of the total land in the study area and therefore implies an insignificant impact. Currently, there are no plans for building structures within the Basin Plan Alternative right-of-way.

III.1.2 OPERATION IMPACTS

Physical Environment

Operation of the Basin Plan Alternative will have potential long-term impacts on Bay water quality, hydrology, sediment quality, and noise. It is expected that normal operation will have no impact on topography, geology, seismicity, soils, groundwater, meteorology, or air quality.

Hydrology. Operation of a treated wastewater conveyance facility will divert "freshwater" inflow from the South Bay to the Lower Bay. The diversion will cause a decrease in annual freshwater inflow into the South Bay.

Although data on existing freshwater inflow to the South Bay are not extensive, it appears that diversion of the wastewater effluent will reduce the total annual freshwater (that is, not salt water) inflow to the South Bay by about 40 percent. The bulk of the remaining freshwater inflow occurs during the rainy season between October and March (see Section II.1.1). During the winter, therefore, the Basin Plan Alternative will reduce the freshwater inflow by less than 40 percent, while during the dry summer months freshwater inflow to the South Bay will be essentially nonexistent. During these same summer months, the evaporation rate from the surface of the South Bay is highest. It is expected that a net flow of water into the South Bay through the Dumbarton Straits of up to 1,000 cubic feet per second is required to compensate for evaporative loss during the summer months (Hydroscience, 1972).

The reduction of freshwater input to the South Bay will result in both positive and negative impacts on the estuary. On the positive side, there will be improvements in water quality in the open waters of South Bay. On the negative side, minor changes will occur in certain water quality parameters in the South Bay and Lower Bay and existing freshwater habitats will be lost; both of these effects are discussed below.

Water Quality. The net result of the Basin Plan Alternative will be general improvement in water quality in the open waters of the South Bay, without significant degradation in water quality throughout the rest of the Bay. However, water quality in extremities of the sloughs will not meet DO criteria and in some instances, may not differ significantly from the no further action alternative. In addition, a relative toxicity level of approximately 50 ml/l would occur at times, exceeding the 40 ml/l guideline.

An analysis of probable changes in water quality in the Bay due to improved treatment and transport of wastewater has been prepared by the Bay Area Sewage Services Agency (BASSA, 1975). Pertinent portions of BASSA's report have been reproduced in Appendix K. The results of water quality modeling by Hydroscience, Inc. are included in Appendix C. The results of these reports are summarized below. The Hydroscience modeling program is described in Exhibit III.1.

Construction of the Basin Plan Alternative would be accompanied by concurrent general improvement in wastewater effluent quality due to improved treatment at the

Exhibit III-1

EVALUATION OF DISCHARGE ALTERNATIVES
AN INTRODUCTION TO THE HYDROSCIENCE MODEL

One tool for analysis and prediction of water quality problems is a mathematical model. Such a model utilizes mathematical equations to represent the interaction of physical, chemical, and biological components of an aquatic system. To the extent that the model's equations accurately and completely represent interactions in a real aquatic system, the model may be used to project future water quality resulting from changes in the real system.

A mathematical model developed by Hydroscience, Inc. was used for purposes of this draft EIR/EIS to assess the water quality impacts of four alternative discharge systems in South San Francisco Bay. The four alternatives are described in detail in the text of the EIS (Sections I and IV). Briefly, they are variations on treatment and disposal methods that assume that currently approved treatment facilities will be constructed:

- *Basin Plan Alternative* — Alternative 1 — consists of a conveyance pipeline connecting the three treatment plants with a disposal outfall at a point in deep water north of Dumbarton Bridge. No additional treatment beyond that currently approved.

- *No Further Action* — Alternative 2 — would implement currently approved treatment and continue local discharge.

- *Individual Deepwater Discharges* — Alternative 3 — consists of conveyances from each treatment plant to the nearest deep water in South Bay. No additional treatment beyond that currently approved.

- *Upgraded Treatment* — Alternative 4 — consists of increasing treatment at San Jose/Santa Clara, limiting 1985 oxygen demand to 11,000 pounds per day. Discharge points would continue at the present locations. No additional treatment beyond that currently approved for Palo Alto or Sunnyvale.

The Hydroscience model was used to project water quality levels in the South Bay resulting from the implementation of each of these four alternatives.

The Model. The Hydroscience model predicts steady state, average water quality conditions for a typical dry season (June through September), wet season (November through February, and canning season (August through October). The steady state model assumes that the aquatic system is in equilibrium with its surroundings and that water quality characteristics are constant for a given time period in a specified segment of the Bay. Variations in water quality characteristics are averaged over the time period used. This steady state condition is seldom achieved in estuaries because of the daily variation in tides, and the Hydroscience model, therefore, describes seasonal average conditions only.

The water quality parameters predicted by the model are dissolved oxygen, five-day BOD, silica, chloride, and ammonia nitrogen. Relative toxicity, an indicator of a discharge's toxic effects on biota, was also included. This latter parameter is a gross measure of a combination of numerous acute effects of a waste on test organisms under idealized conditions and can only be used qualitatively where order-of-magnitude changes are apparent.

In the model, the Bay is represented as a grid, or series of segments, whose geometry and hydraulics reflect mean tidal conditions. The grid used is shown in Figure 3 of the Hydroscience Inc. report dated 1976 (Appendix C). As originally applied in Consoer-Bechtel (1972), this model included only the South Bay; in subsequent applications the model was enlarged to include sloughs adjacent and tributary to the South Bay.

Calibration and Verification. The mathematical equations comprising a model must accurately describe the physical, chemical, and biological interactions within an aquatic system before the model may be used to predict future water quality of the system. The first step in utilizing a model, therefore, involves choosing reaction rate coefficients and background loading rates that are characteristic of the aquatic system being modeled. This process is known as "calibrating" the model. In principle, if the proper coefficients and rates are chosen and all important interactions within an aquatic system are represented in the mathematical equations, then the model should be able to predict water quality levels in the existing aquatic system. Thus, these coefficients and rates are adjusted until water quality levels predicted by the model match water quality levels measured in the field. The model is then said to be calibrated.

To be sure that the calibrated model will accurately predict water quality levels under a variety of conditions, input parameters such as temperature and waste inflows are varied according to observed seasonal fluctuations in these parameters. If, under these new conditions, the model is still able to reproduce water quality levels measured in the field, then the model is said to be "verified" and is considered to adequately represent the behavior of the real aquatic system.

Water quality data collected during the summers of 1960-1964, March 1968, October 1977, and November 1977 were used to calibrate and/or verify the Hydroscience model. The model was calibrated both for the open waters of the South Bay and for the adjacent sloughs.

Assumed Base Conditions. The Hydroscience model was used to predict water quality levels in 1985 and 1995 resulting from each of four waste discharge alternatives. In order to make these predictions, it was necessary to assume that currently approved treatment facilities will be constructed (described in the Bechtel 1974 report and Section 1 of this EIS). Other treatment agencies and authorities that discharge to the Bay south of the San Mateo Bridge were identified, and their 1985 locations were obtained. The dischargers (East Bay Dischargers, Livermore-Amador Valley, and South Bayside) are described in their respective EIR's and in Section II.3 of this EIS.

Standards. Water quality standards against which model results are compared are those presented in the *Basin Plan* (SWRCB and RWQCB, 1975). These are: (1) In the Bay south of the Carquinez Straits, oxygen levels shall not be less than 5.0 mg/l; (2) Where natural factors cause lower concentrations, controllable water quality factors shall not cause further reduction; (3) In addition, all waters designated as aquatic life habitat shall be maintained at "protection level B," which defines the lower 90 percentile relationship between measured dissolved oxygen concentrations and oxygen saturation concentrations.

Model Findings. The Hydroscience model was used to predict water quality levels for three seasons in each of the years 1985 and 1995. The three seasons — dry, wet, and canning — were identified on the basis of average seasonal variation in rainfall and variation of inflows from the canning industry.

As an example of the model's usefulness as an impact assessment tool, the model results for the 1995 canning season were used to estimate the spatial extent of violations of the dissolved oxygen standard along the Main Bay Transect and along sloughs in the South Bay. The following information was taken from the 1978 Hydroscience report (Appendix C):

Alternative	**Estimated Number of Transect Miles at less than 5.0 mg/l Dissolved Oxygen**			
	Main Bay (Transect Length = 17 miles)	**Artesian Slough (Transect Length = 2.5 miles)**	**Guadalupe Slough (Transect Length = 6 miles)**	**Alviso Slough (Transect Length = 3 miles)**
Basin Plan Alternative	0	2.5	0	3
Individual Deep-water Discharges	0	2.5	0	3
Upgraded Treatment	2.5	2.5	5	3
No Further Action	4-6.5	2.5	5	3

Limitations of the Model. All mathematical models are limited by the assumptions and the data used to define them. In interpreting the Hydroscience model results, an awareness of the limitations of the model is necessary. Some of the more important limitations are:

- The model is a steady state description of a non-steady state system. In other words, factors that vary over time (tides, light, flows, wind, and others) are assumed to be constant in the model, and "average values" of parameters affected by these factors are selected for these constants.

- The model is insensitive to some parameters; this insensitivity results in wide variation in estimation of DO levels in some locations. For example, a sensitivity analysis of the model (Appendix C, 1978 report) indicated that certain regions of the Bay (main Bay transect, Guadalupe Slough, Alviso Slough, Newark Slough) are quite sensitive to the nitrification rate, which in turn affects marsh loading estimates. However, only Alviso, Mowry, and Newark Sloughs are sensitive to marsh loadings themselves. Therefore, adjustment of nitrification rates and marsh loadings for calibration of Guadalupe Slough could result in good agreement in Guadalupe, while taking Mowry Slough out of agreement. Another parameter of concern is bottom demand and its relationship with the reaeration coefficient. Therefore, some portions of the Bay may be over-or under-estimated, depending on the loading-rate coefficient factors used. The complexity of the Bay (Appendix H) is not consistant with this result; a number of loadings, reaction rate coefficients, and other parameters probably work in a complex fashion throughout the Bay, and in different ways in each portion of the Bay being studied. Not enough data or knowledge on how the Bay works are available to make a model totally responsive to these complex interactions, and therefore, the model results in a broad, averaging conclusion rather than in tight predictions of future conditions.

- The steady state model generates an average, or mean, result; however, stochastic (probability) methods were used to provide information on non-steady state variability within the steady state model. This was necessary in order to determine the probability of significant variations from the mean DO level and the likelihood of causing death or significant damage in biological systems. Also, Hydroscience used linear variability (assumed that effects are additive), where some effects may interact and result in more or less variability than the stochastic method predicts.

- Assumptions in the model which were not verified with field work or which were based on limited data limit application of this model. These assumptions include: (1) Bay and slough waters are well-mixed and transport mechanisms can be determined from salinity measurements; (2) Benthic oxygen demand and reaeration rates were based on "typical" and "optimistic" values for estuaries; (3) An average of a parameter over depth, or the use of a value from a specified depth, can simulate the behavior of a three-dimensional system in a two-dimensional model.

Indeed, it may be that no mathematical or physical model can accurately predict conditions in San Francisco Bay. These limitations do not necessarily invalidate the model or its results. However, the results can be considered with other factors in the selection of a water quality management program. These factors include the actual chemical data describing Bay water quality in the past (University of California, 1966) and present (Appendices D, E, and H), as well as analysis of the probable effects of changes in water quality on biota and on people by technicians experienced with the behavior of estuarine systems, water treatment, and, in particular, South San Francisco Bay.

three SBDA treatment plants, as well as by a similar diversion project involving wastewater discharges in the Union Sanitary District (EPA, 1975c). The transport project without currently approved treatment improvements would improve water quality in the South Bay, with a corresponding decrease in water quality near the point of discharge north of the Dumbarton Bridge (BASSA, 1975). Since upgraded treatment would accompany the transport system, however, a severe decrease in water quality at the discharge point would not occur (Appendix C).

The most drastic alteration in water quality would occur in those sloughs in the South Bay now receiving point source discharges.

- Distribution of Treated Wastewater in Bay Water. The total wastewater input to the Bay would not change as a result of implementation of the Basin Plan Alternative; there would, however, be a significant change in the distribution of wastewater in the Bay. BASSA (1975) projections indicate that operation of an SBDA conveyance facility should reduce the treated wastewater content of the South Bay from the current range of 10 to 40 percent of the total volume of water (Dumbarton Bridge to Alviso Slough, respectively), to approximately 7 percent throughout the South Bay. According to BASSA (1975), implementation of all currently planned improvements in wastewater treatment in addition to conveyance should reduce the wastewater content of the South Bay to between 3 to 7 percent of the water volume, with the higher concentration near the Dumbarton Bridge, and the potential reduction of relative toxicity levels predicted by Hydroscience (Appendix C) tend to support this premise. Wastewater content of the South Bay would never drop to zero, because some treated wastewater would be transported in and out of the Basin Plan discharge site north of Dumbarton Strait.

  The highest concentration of treated wastewater in the Bay would be at the disposal site north of Dumbarton Bridge. BASSA (1975) estimated the wastewater concentration to be about 7 percent at the disposal site, as it is now. This figure is compatible with the 16.4:1 dilution design factor of the Basin Plan Alternative diffuser. North of the disposal site there would be little change in the concentration of wastewater from all dischargers in the Bay. The concentration would gradually drop to about one percent in the vicinity of the Bay Bridge, as it does now. The only major reduction in wastewater concentration if the conveyance system goes into operation would be in the waters of the South Bay (BASSA, 1975).

- Dissolved Oxygen and Biochemical Oxygen Demand. Elimination of wastewater discharges to the South Bay and the planned upgraded wastewater treatment would result in increased dissolved oxygen (DO) concentrations in the open waters of the South Bay. BASSA (1975) projections indicate that the implementation of all proposed wastewater diversions, coupled with upgraded wastewater treatment, would increase the DO levels in the South Bay to approximately 95 percent of saturation (approximately 6 to 7 mg/l). The Hydroscience study (Appendix C and Figure III-1) shows that these improvements are significant when compared to the 1967 levels of oxygen saturation in the South Bay and to the proposed DO criteria that require 5.0 mg/l. However, except for the lower two or three miles of the Bay, the Basin Plan Alternative is not significantly different from a no further action alternative (see also Section IV.2.9), in that DO standards will not be met in all the extremities of the Bay.

  In the lower two or three miles of the Bay, DO concentrations would be expected to deteriorate somewhat in the headwaters of Artesian Slough, due to a lack of flushing (now allowed by wastewater flows) and a resultant expression of background oxygen demand in the sloughs. The Hydroscience model (Appendix C) defines this background demand as the loadings attributable to benthic demand and to oxygen demands from marshes. Similarly, a slight depression in DO levels is expected in the vicinity of the discharge point in the Lower Bay.

- Salinity. Minor variations in Bay water salinity would result from operation of the Basin Plan Alternative (Figure III-2). The South Bay would lose a significant portion of its annual freshwater input when the treated wastewater is diverted northward. This diversion would result in salinity increases in the South Bay, especially in the southern reaches. Salinity increases would be largest in the sloughs now receiving wastewater discharges and partically insulated from tidal fluxes. Salinities in these areas would exhibit strong seasonal variations, becoming lower in the rainy winter months. Salinity variations in the open waters of the South Bay would be much less pronounced due to the extensive tidal flushing. However, the location of the diffuser in deep water north of Dumbarton Bridge would result in a mixing zone with reduced salinity due to wastewater discharge in an area previously not subjected to such discharges. This mixing zone is not expected to affect significantly the salinity of the open waters of the Bay, however (Figure III-2 and Appendix H).

- Toxicity. Projected toxicity conditions in the Bay, based on the assumption that 95 percent of the test organisms (the stickleback) survive a bioassay test of undiluted effluent, are shown in Figure III-3. The toxicity levels in the South Bay would decrease with the removal of waste loads. Hydroscience (Appendix C) calculated the difference in toxicity with a no further action alternative and implementation of the Basin Plan Alternative to be as much as an order of magnitude (ten times the relative toxicity for no further action as for the Basin Plan Alternative) in the South Bay. The Basin Plan Alternative does not meet the toxicity guideline of 40 ml/l (see Exhibit III-1), even in the relatively well-mixed waters near Dumbarton Bridge, although the 50 ml/l estimate by Hydroscience is close to the guideline and may be within the computation error expected from the model.

Sediment Quality. The effects of the Basin Plan Alternative on sediment quality in the South Bay are speculative. In general, the net direction of movement of pollutants in most natural waters is from the water phase into the sediment. Except under anaerobic conditions, movement of materials in the opposite direction is not understood. There is, however, little correlation between sediment concentration of an element and its concentration in the overlying water (Lee, 1970). Furthermore, the rates of exchange of pollutants and other materials between sediments and water are a function of a complex set of environmental factors, including hydrodynamics, sediment mixing, biochemical processes, pH, redox potential, solubilities, complex ion formation, and sorption (see Lee, 1970, or Lee and Plumb, 1974, for amplification). It can be assumed that pollutants in the sediments of the South Bay have resulted primarily from poor water quality caused by past discharge of incompletely treated wastes. Improvements in water quality will mitigate any tendency for further deterioration of sediments in the South Bay; however, actual improvements in sediment quality cannot be guaranteed.

On the other hand, sediment quality near the Basin Plan Alternative diffuser site in the Lower Bay would probably deteriorate to some degree as a result of the diverted wastewater. As before, the degree of impairment of sediment quality is not known. Many of the potential pollutants found in treated wastewater, such as suspended matter, oil and grease, and heavy metals, tend to associate with the sediments. These materials may be carried for some distance in the receiving water, however, before being removed. The environmental chemistry of many pollutants, especially the metals, is complex (see Morel et al., 1975; Helz et al., 1975). Several metals, such as zinc, copper, and lead, are rapidly removed from the water and held rather tightly in the sediments by physical and chemical mechanisms. Others such as nickel and cobalt, can be slightly soluble under certain conditions, and several, like iron and manganese, can be very soluble in a strongly

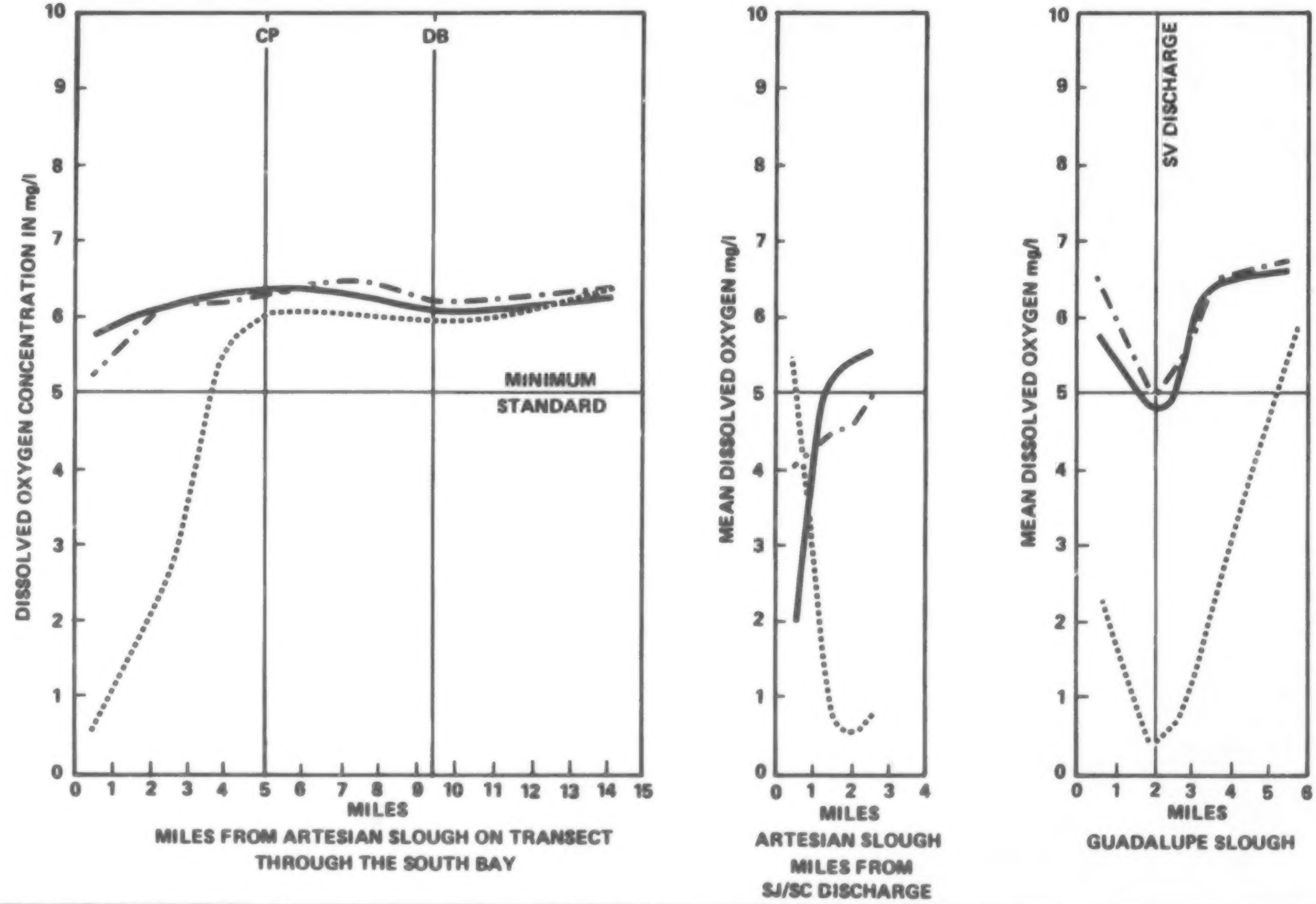


Figure III-1
MEAN DISSOLVED OXYGEN LEVELS RESULTING FROM IMPLEMENTATION OF THE BASIN PLAN ALTERNATIVE (ADOPTED FROM HYDROSCIENCE, INC., APPENDIX C).

CONTENTS

Section Page

I DESCRIPTION OF BASIN PLAN AND ALTERNATIVES
I.1 DESCRIPTION OF ALTERNATIVES 1 1/D13
I.1.1 Introduction 1 1/D13
I.1.2 Background and Objectives 4 1/E5
I.1.3 Criteria for Evaluation of Alternatives 6 1/E9
I.1.4 Evaluation of Alternatives 6 1/E9
Alternative 2 — No Further Action 9 1/F1
Alternative 3 — Individual Outfalls to Nearest Deepwater 10 1/F3
Alternative 4 — Local Discharge with Upgraded Treatment 11 1/F5
Alternative 5 — Reclamation and Reuse of Treated Wastewater 13 1/F9
I.1.5 Alternative Alignments to Basin Plan Alternative 15 1/F13
I.2 THE BASIN PLAN ALTERNATIVE 19 1/G7
I.2.1 Location 19 1/G7
I.2.2 Facilities for the Basin Plan Alternative 21 1/G11
San Jose/Santa Clara Pumping Station 22 1/G13
Pipeline Segment — San Jose Santa Clara to Sunnyvale 22 1/G13
Sunnyvale Pumping Station 22 1/G13
Pipeline Segment — Sunnyvale to Palo Alto 24 2/B1
Palo Alto Pumping Station 24 2/B1
Pipeline Segment — Palo Alto to Discharge Point 24 2/B1
Diffuser 24 2/B1
I.2.3 Construction of the Basin Plan Alternative 25 2/B3
Construction Procedures on Land 25 2/B3
Construction Procedures in Water 26 2/B5
I.2.4 Operation of the Basin Plan Alternative 28 2/B9
I.3 APPROVALS REQUIRED 29 2/B11
II ENVIRONMENTAL DESCRIPTION
II.1 PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT) 31 2/C3
II.1.1 Physical Environment 31 2/C3
Topography 31 2/C3
Geology and Seismology 33 2/C7
Groundwater 33 2/C7
Soils 36 2/C13
Sediments 37 2/D1
Meteorology 39 2/D5
Air Quality 40 2/D7
– The Air Pollution Problem in the Bay Area 40 2/D7
– Emissions and Air Quality 40 2/D7
– Air Quality in the Bay Area 45 2/E3
– Air Impacts of Wastewater Disposal 45 2/E3
Hydrology 45 2/E3
– Tides and Currents 46 2/E5
– Circulation and Dispersion 47 2/E7
Water Quality 49 2/E11
– Temperature 51 2/F1
– Transparency 51 2/F1
– pH 51 2/F1
– Suspended Solids 51 2/F1
– Salinity 52 2/F3
– Dissolved Oxygen and Oxygen Demand 53 2/F5
– Nutrients 53 2/F5
– Chlorophyll 54 2/F7
– Coliform Bacteria 54 2/F7
– Oil and Grease 55 2/F9
– Toxicity 55 2/F9
– Heavy Metals 57 2/F13
Noise 57 2/F13
II.1.2 Biological Environment 58 2/G1
South Bay Habitats 58 2/G1
– Open Water 61 2/G7
– Tidal Mud Flats 64 2/G13
– Salt Marsh 68 3/B5
– Salt Ponds 71 3/B11
Dikes and Levees 74 3/C3
– Grasslands 75 3/C5
– Streams and Sloughs 75 3/C5
– Freshwater Marshes and Ponds 77 3/C9
Species of Special Concern 78 3/C11

II.1.3 Social, Economic, and Cultural Environment 83 3/D7
Population and Demography 83 3/D7
Recreational and Scientific Uses of the Area 87 3/E1
Archaeological, Paleontological, Historical and Cultural Resources 88 3/E3
— Archaeological Resources 88 3/E3
— Paleontological Resources 89 3/E5
— Historical and Cultural Resources 89 3/E5
Visual and Aesthetic Setting 93 3/E13
Economic Setting 98 3/F9

II.2 LAND USE

II.2.1 Present Land-Use Patterns 101 3/G1
Existing Land Use 101 3/G1
— Santa Clara County 101 3/G1
— San Mateo County 104 3/G7
Existing Public and Private Developments 104 3/G7
Mineral Resources of the Baylands 112 4/B7
II.2.2 Projected Land-Use Patterns 112 4/B7
Planned Public and Private Developments 112 4/B7
Land-Use Plans and Planning Agencies 114 4/B11
Interested Agencies 118 4/C5
— Local 118 4/C5
— Regional 118 4/C5
— State 118 4/C5
— Federal 119 4/C7

II.3 WATER USE

II.3.1 Existing and Proposed Wastewater Treatment Facilities 120 4/C9
San Jose/Santa Clara Regional Water Pollution Control Plant 120 4/C9
Sunnyvale Water Pollution Control Plant 120 4/C9
Palo Alto Treatment Plant 121 4/C11
Menlo Park Sanitary District Wastewater Treatment Plant 121 4/C11
Redwood City Sanitary District — Redwood City Sewage Treatment Facility 121 4/C11
Redwood City Sanitary District — Redwood Shores Plant 122 4/C13
Belmont/San Carlos Joint Sewage Treatment Facility 122 4/C13
Proposed Redwood Shores Subregional Plant 122 4/C13
Union Sanitary District — Alvarado, Plant No. 3 122 4/C13
Union Sanitary District — Newark, Plant No. 1 122 4/C13
Union Sanitary District — Irvington, Plant No. 2 122 4/C13
II.3.2 Current and Projected Sources of Water 122 4/C13
II.3.3 Current Water Use and Projected Demand 123 4/D1
II.3.4 Current and Projected Water Quality 123 4/D1

III ENVIRONMENTAL IMPACTS

III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129 4/E1
III.1.1 Construction Impacts 129 4/E1
Physical Environment 129 4/E1
— Topography 129 4/E1
— Air Quality 130 4/E3
— Water Quality 131 4/E5
— Sediment Quality 132 4/E7
— Noise 132 4/E7
Biological Environment 133 4/E9
— Segment I — San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134 4/E11
— Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant 136 4/F1
— Segment III — Palo Alto Treatment Plant to Discharge Point 138 4/F5
Social, Economic, and Cultural Environment 140 4/F9
— Recreational Uses of the Area 140 4/F9

- Archaeological, Paleontological, and Historical Resources 141 4/F11
- Visual and Aesthetic Setting 141 4/F11
- Economic Setting 141 4/F11
- Present Land-Use Patterns 143 4/G1
- Projected Land-Use Patterns 144 4/G3

III.1.2 Operation Impacts 144 4/G3
Physical Environment 144 4/G3
- Hydrology 144 4/G3
- Water Quality 144 4/G3
- Sediment Quality 148 4/G11
- Noise 150 5/A13

Biological Environment 152 5/B3
Social, Economic, and Cultural Environment 154 5/B7
- Recreational Uses of the Area 154 5/B7
- Visual and Aesthetic Setting 155 5/B9
- Present and Future Land-Use 155 5/B9
- Energy Consumption 155 5/B9

III.1.3 Economic Impact of the Basin Plan Alternative 155 5/B9
Introduction 155 5/B9
Study Assumptions and Methodology 155 5/B9
- Capital Costs 156 5/B11
- Operation and Maintenance Costs 158 5/C1

Computation of Allocation Factors 158 5/C1
User Charges to Discharger Groups 159 5/C3
- Residential Dischargers 159 5/C3
- Commercial Dischargers 159 5/C3
- Industrial Dischargers 159 5/C3
- Direct Impact on Industrial Dischargers 162 5/C9

Analysis of the Canned Fruit and Vegetable Industry 163 5/C11
- Industry Characteristics 163 5/C11
- Methodology 164 5/C13
- Conclusions of Analysis 165 5/D1

Conclusions 165 5/D1
III.1.4 Accident or Natural Catastrophe 166 5/D3
Flooding 166 5/D3
Earthquake 166 5/D3
Plant Upset 166 5/D3
Pumping Station Malfunction 166 5/D3

III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168 5/D7
III.2.1 Adverse Construction Effects 168 5/D7
Physical Environment 168 5/D7
Biological Environment 168 5/D7
Social, Economic, and Cultural Environment 168 5/D7
III.2.2 Adverse Operational Effects 169 5/D9
Physical Environment 169 5/D9
Biological Environment 169 5/D9
Social, Economic, and Cultural Environment 169 5/D9
III.3 MITIGATION MEASURES 170 5/D11
III.3.1 Mitigation of Construction Impacts 170 5/D11
Proposed Measures 170 5/D11
Potential Measures 172 5/E2
III.3.2 Mitigation of Operation Impacts 173 5/E3
Proposed Measures 173 5/E3
Potential Measures 173 5/E3
III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174 5/E5
III.4.1 Short-Term Uses of Man's Environment 174 5/E5
III.4.2 Maintenance and Enhancement of Long-Term Productivity 174 5/E5
III.4.3 Need for the Project 175 5/E7
III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176 5/E9
III.5.1 Permanent Changes in Land Features and Land Use 177 5/E11
III.5.2 Biological Systems 177 5/E11
III.5.3 Assimilative Capacity of the Bay 177 5/E11
III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177 5/E11
III.6 GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178 5/E13

IV ALTERNATIVES TO THE BASIN PLAN

IV.1 INTRODUCTION 181 5/F7
IV.2 ALTERNATIVES 182 5/F9

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183 5/F11
Participation by Other Entities 184 5/F13
Alternative Alignments 184 5/F13
Result of Screening 185 5/G1
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188 5/G7
Result of Screening 190 5/G11
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190 5/G11
Result of Screening 191 5/G13
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193 6/B1
Result of Screening 195 6/B5
IV.2.5 Alternative 5 — Reclamation and Reuse 195 6/B5
Reclamation in Santa Clara County 197 6/B9
Smaller Reuse Markets in the Service Area 199 6/B13
Markets Outside the Service Area 201 6/C3
Result of Screening 202 6/C5
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202 6/C5
Result of Screening 203 6/C7
IV.2.7 Alternative 7 - Discharge to the Ocean 203 6/C7
Result of Screening 204 6/C9
IV.2.8 Alternative 8 — Land Disposal 204 6/C9
Result of Screening 205 6/C11
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206 6/C13
Result of Screening 206 6/C13

V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION

V.1 INTRODUCTION 207 6/D3
V.2 STUDY AREA 209 6/D7
V.2.1 Location of Study Area 210 6/D9
V.2.2 Water Demand and Supply 210 6/D9
V.2.3 Quality of Groundwater Supplies 213 6/E1
V.2.4 Quality of Soils 213 6/E1
V.2.5 Agricultural Land Use 215 6/E5
V.3 CONCEPTUAL DESIGN 217 6/E9
V.3.1 Potential Markets 218 6/E11
V.3.2 Reclaimed Water Quality 219 6/E13
Source Control 221 6/F3
Level of Reclaimed Water Treatment 222 6/F5
V.3.3 Treatment Conceptual Designs 224 6/F9
Reclaimed Water Flow Diversion 226 6/F13
Coagulation and Sedimentation with Alkalinity Control 226 6/F13
Alkalinity Control 230 6/G7
Partial Desalination Treatment 232 6/G11
V.3.4 Conveyance and Distribution Conceptual Designs 233 6/G13
Pumping 234 7/A13
Conveyance Pipeline 235 7/B1
Santa Clara Valley Distribution System 236 7/B3
Bolsa Distribution System 236 7/B3
User Connections 236 7/B3
V.3.5 Cost Estimates 242 7/C1
Basis of Estimate 242 7/C1
Engineering Construction Management Contingency 244 7/C5
Escalation 244 7/C5
Schedule 244 7/C5
Operation and Maintenance 244 7/C5
Major Exclusions 244 7/C5
Assumptions 244 7/C5
V.3.6 Blending Alternatives 244 7/C5
Blended Water Quality 245 7/C7
Blended Water Markets 245 7/C7
Blended Water Distribution 246 7/C9
Blending System Alternatives 247 7/C11
V.3.7 Alternating Supply Alternatives 247 7/C11
V.3.8 Summary 248 7/C13
V.4 AGRICULTURAL IMPACTS 249 7/D1
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250 7/D3
Salinity Effects 251 7/D5
Effects of High Sodium Concentrations 253 7/D9

Specific Ion Toxicity 255 7/D13
Summary of Effects on Agriculture of Cases A and B 255 7/D13
V.4.2 Impact of Cases C, D, B_1, B_2, and B_3 in the Santa Clara County Portion of the Study Area 256 7/E1
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257 7/E3
V.5 ECONOMIC IMPACT ANALYSIS 259 7/E7
V.5.1 Conceptual Level Costs 259 7/E7
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260 7/E9
V.5.3 Economic Impact on Agriculture 260 7/E9
V.6 OTHER IMPACTS 263 7/F1
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264 7/F3
V.6.2 Long-Term Buildup of Salts in Soil 265 7/F5
V.6.3 Public Health Concerns 265 7/F5
V.6.4 Effects on Land Use and Water Use 266 7/F7
V.6.5 Energy Consumption 266 7/F7
V.6.6 Other Effects 267 7/F9
VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE
VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270 7/G3
VI.1.1 Disposal of Bittern 271 7/G5
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272 7/G7
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273 7/G9
VI.1.4 Other Disposal Alternatives 276 8/A13
Continued Storage 276 8/A13
On-Land Dilution 276 8/A13
VI.2 PRESENT ENVIRONMENT 277 8/B1
VI.2.1 Physical Environment 277 8/B1
Topography 277 8/B1
Soils 278 8/B3
Sediments 278 8/B3
Hydrology 278 8/B3
Water Quality 278 8/B3
— Temperature and Salinity 278 8/B3
— Chemical Characteristics 280 8/B7
VI.2.2 Biological Environment 280 8/B7
Open Water and Tidal Mud Flats 280 8/B7
Salt Marsh 280 8/B7
Salt Ponds 280 8/B7
Dikes and Levees 282 8/B11
Streams and Sloughs 282 8/B11
Species of Special Concern 283 8/B13
VI.2.3 Social and Cultural Environment 283 8/B13
Recreational Uses of the Area 283 8/B13
Archaeological, Paleontological, Historical, and Cultural Resources 284 8/C1
Visual and Aesthetic Setting 284 8/C1
Existing and Proposed Land Use 284 8/C1
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285 8/C3
VI.3.1 Discharging to Basin Plan Alternative 285 8/C3
Construction Impacts — Physical Environment 285 8/C3
— Topography 285 8/C3
— Air Quality 285 8/C3
— Water Quality 286 8/C5
— Sediment Quality 286 8/C5
— Noise 286 8/C5
Construction Impacts — Biological Environment 286 8/C5
— Salt Pond Dikes 286 8/C5
— Open Water 286 8/C5
Construction Impacts — Social, Economic, and Cultural Environment 287 8/C7
— Recreational Uses of the Area 287 8/C7
— Archaeological, Paleontological, and Historical Resources 287 8/C7
— Economic Setting 287 8/C7
— Present and Projected Land-Use Patterns 287 8/C7
Operational Impacts — Physical Environment 287 8/C7
— Water Quality 287 8/C7
— Sediment Quality 290 8/C13
— Noise 290 8/C13
Operational Impacts — Biological Environment 291 8/D1

Operational Impacts — Social, Economic, and Cultural Environment 292 8/D3
— Economic Setting 292 8/D3
VI.3.2 Discharging Through Separate Diffusers 292 8/D3
Construction Impacts — Physical Environment 292 8/D3
— Topography 292 8/D3
— Air Quality 292 8/D3
— Water Quality 292 8/D3
— Sediment Quality 292 8/D3
— Noise 292 8/D3
Construction Impacts — Biological Environment 293 8/D5
— Salt Pond Dikes 293 8/D5
— Open Water 293 8/D5
Construction Impacts — Social, Economic, and Cultural Environment 293 8/D5
— Recreational Uses of the Area 293 8/D5
— Visual and Aesthetic Setting 293 8/D5
— Economic Setting 293 8/D5
— Present and Projected Land-Use Pattern 294 8/D7
Operational Impacts — Physical Environment 294 8/D7
— Water Quality 294 8/D7
— Sediment Quality 295 8/D9
— Noise 295 8/D9
Operational Impacts - Biological Environment 296 8/D11
Operational Impacts — Social, Economic, and Cultural Environment 297 8/D13
— Economic Setting 297 8/D13
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298 8/E1
VI.4.1 Unavoidable Adverse Environmental Impacts 298 8/E1
VI.4.2 Mitigation Measures 298 8/E1
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299 8/E3
Short-Term Uses of Man's Environment 299 8/E3
Maintenance or Enhancement of Long-Term Productivity 299 8/E3
Need for the Project 299 8/E3
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302 8/E9
Permanent Changes in Land Features and Land Use 302 8/E9
Biological Systems 302 8/E9
Assimilative Capacity of the Bay 302 8/E9
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302 8/E9
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302 8/E9

VII SOURCES OF INFORMATION

VII.1 REFERENCES 305 8/F1
VII.1.1 Literature Cited in Text 305 8/F1
VII.1.2 Literature Cited in Figures 312 8/G1
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313 8/G3
VII.3 CONTACTS 316 8/G9
VII.4 DISTRIBUTION LIST 335 9/D3
VII.4.1 Federal Agencies 335 9/D3
VII.4.2 Libraries 338 9/D9
VII.4.3 Individuals and Private Groups 339 9/D11
VII.4.4 State Agencies 347 9/E13
VII.4.5 Regional Agencies and Local Government 348 9/F1
VII.4.6 Legislators 352 9/F9
VII.4.7 News Media 353 9/F11

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

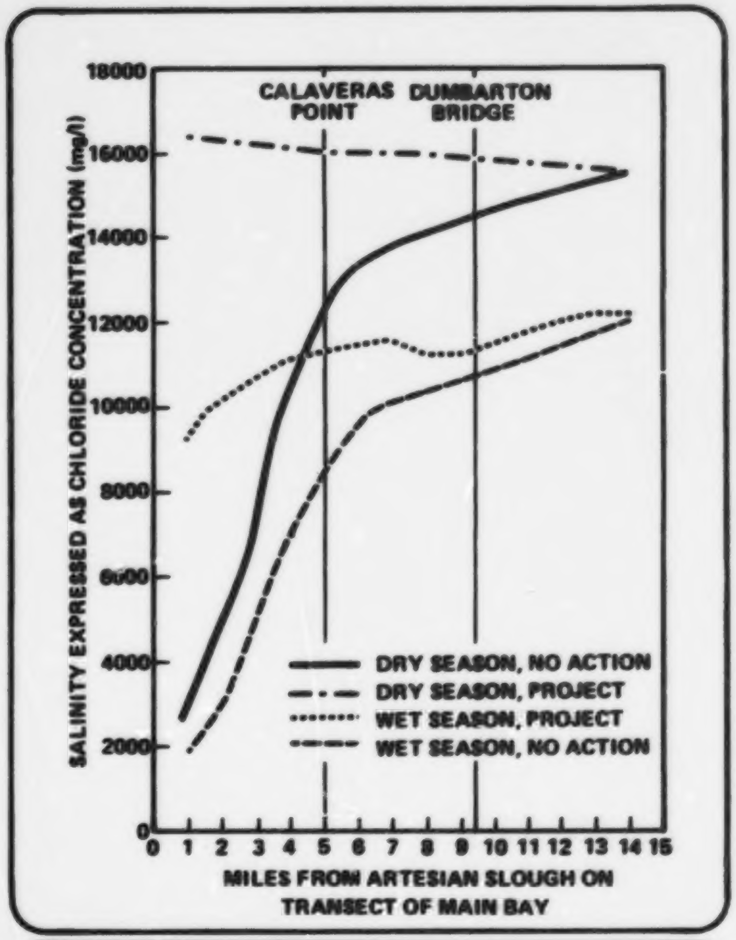


Figure III-2
PROJECTED SALINITY IN THE SOUTH BAY RESULTING FROM IMPLEMENTATION OF THE BASIN PLAN ALTERNATIVE (ADOPTED FROM HYDROSCIENCE, INC., APPENDIX C).

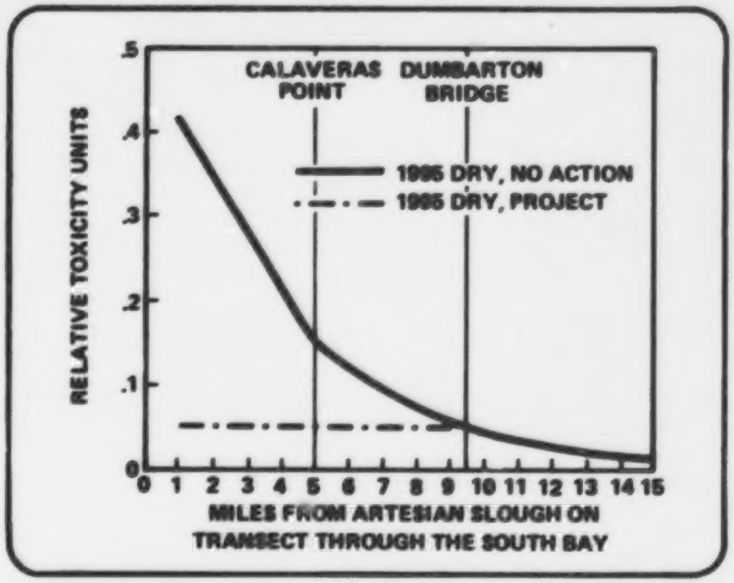


Figure III-3
RELATIVE TOXICITY IN THE SOUTH BAY RESULTING FROM IMPLEMENTATION OF THE BASIN PLAN ALTERNATIVE (ADOPTED FROM HYDROSCIENCE, INC. APPENDIX C).

reducing environment (not found in the Lower Bay). It is likely that the sediments in the vicinity of the diffuser would incur an increase in conservative pollutants, but the degree of impact on biota is uncertain.

Noise. The increased noise from the operation of the Basin Plan Alternative would be confined to the areas around the three pumping stations located adjacent to the Palo Alto, Sunnyvale, and San Jose/Santa Clara treatment plants. Each pumping station would have two sets of pumps; one set to handle normal pumping requirements, the other to handle peak pumping requirements during rainy periods. There would be three or four pumps at each station to handle normal pumping requirements and four to seven pumps to handle the entire flow during rainy periods (Section I.1).

Table III-4

ASSUMED PUMP OPERATING CONDITIONS

Description	Number Operating	Flow Rate (1,000 gpm)	hp	rpm
San Jose/ Santa Clara				
Normal	3	40	300	<800
Peak	4	45	1,050	<800
Sunnyvale				
Normal	3	44	575	<800
Peak	5	47	1,700	<800
Palo Alto				
Normal	4	45	725	<800
Peak	7	42	2,000	<800

The estimated noise levels were compared to:

- Measured baseline noise levels (Section II.1.1)
- Requisite levels identified by the EPA (Appendix F)

Since the baseline noise levels exceed 55 dBA (the level identified by the EPA as requisite to protect the public from levels that may interfere with outdoor activity), this criterion is not meaningful in assessing the impact. $L_{eq} \leqq 70$ dBA has been identified by the EPA as requisite to protect the public from noise induced hearing loss. The area around each pumping station where the noise level is estimated to exceed 70 dBA was identified.

- Palo Alto Pumping Station. The ambient noise level (L_{90}) measured near the Palo Alto Yacht Club, approximately 2,000 feet from the pumping station site was 50 dBA. The L_{eq} was approximately 59 dBA. With the pumping station (not enclosed) operating, the L_{90} level at the Yacht Club would increase to approximately 60 dBA and 54 dBA for the peak and normal pumping conditions, respectively. The L_{eq} would increase to approximately 62 dBA and 60 dBA, respectively. Noise levels within 800 feet and 400 feet of the station would exceed 70 dBA during both peak and normal conditions. An enclosure for this pumping station could be designed to mitigate these noise levels at the 800- and 400-foot contours (see also Section III.3).

- Sunnyvale Pumping Station. The ambient noise level (L_{90}) and the L_{eq} measured in areas near the Sunnyvale pumping station site were 48 dBA and 65 dBA, respectively. With the pumping station operating, areas within 5,000 feet of the pumping station would experience an L_{90} greater than or equal to 48 dBA during peak operation. Areas within 1,000 feet would experience an L_{eq} greater than or equal to 65 dBA during peak operation. Areas within 700 feet would exceed 70 dBA. During normal operation, areas within 2,600 feet would experience an L_{90} greater than 48 dBA, and areas within 500 feet would experience an L_{eq} greater than 65 dBA. The area within 300 feet would exceed 70 dBA. An enclosure could be designed to mitigate these noise levels at the 700- and 300-foot contours (see also Sections I.1.3 and III.3).

- San Jose/Santa Clara Pumping Station. Residences in Alviso nearest the pumping station site would experience approximately a 3 dB increase in the outside L_{90} of 50 dBA and no measurable increase in the L_{eq} level of 65 dBA during peak operation. During normal operation, there would be no measurable increase in the L_{eq} or L_{90} (above) for these residences. The area within 400 feet during peak operation, and within 200 feet during normal operation, would exceed 70 dBA. Since these contours lie entirely within the property of the San Jose/Santa Clara water pollution control facility, no mitigation of noise levels through the use of enclosures is envisioned.

Biological Environment

The operation of the Basin Plan Alternative will have minor, and probably insignificant, impacts on terrestrial habitats. The only evidence of pipeline operation would be the noise of the pumping stations, which are located in areas of low biological sensitivity, further reducing the likelihood of significant disturbance.

The major biological impacts of operation will occur in the sloughs and the open water habitats. These impacts will result in a net interaction that is complex and difficult to predict with any certainty. The main purpose of the Basin Plan Alternative is to improve the water quality of the South Bay by eliminating the discharge of treated wastewater with a high oxygen demand and high relative toxicities. This wastewater would be released, instead, north of the Dumbarton Bridge where average ambient oxygen levels are higher and where mixing and dispersion are more rapid, reducing relative toxicity levels to near the suggested 40 ml/l guideline. The result is expected to be an increase in average dissolved oxygen levels in the open waters of the South Bay (Section III.1.2, Water Quality), a decrease in the loading of potentially toxic materials to the South Bay, and therefore, an improvement in water quality conditions which might allow the potential biotic productivity of the South Bay to be expressed.

Over the years of operation of the San Jose/Santa Clara treatment plant outfall in Artesian Slough, a unique freshwater floral and faunal association has developed along 2000 yards of its length. If the Basin Plan pipeline goes into operation, the discharge of wastewater to the slough will cease under all but emergency bypass conditions, resulting in an increase in the salinity of the slough system. Within a few years, the cattail and bulrush marshes will die back and be replaced with more salt tolerant forms. Eventually, a salt marsh should develop along the slough banks and on the islands in the lower portion. During this transition, the addition of dead plant material to the organic load in the sediments and the water, combined with a marked reduction of flushing action in the summer, may result in a depletion of dissolved oxygen, causing the sediments and portions of the water column above them in the entire slough system to become anaerobic, perhaps for months or more at a time. The reduced oxygen levels may result in aggravation of recent problems with waterfowl botulism in the South Bay, although increased salinities (over 30 ppt) are known to eliminate the botulism bacterium. The change in plant communities may eliminate roosting and nesting places for freshwater marsh birds and mammals. Until this ecological system can restabilize as a salt marsh and slough, its value to wildlife will be much reduced from its present level. The "value" of the expected new saline environment cannot be directly compared to the existing system; a decrease in habitat diversity in the wildlife refuge is the primary adverse impact expected.

Gill (1973) reported waterfowl breeding in Guadalupe Slough both above and below the Sunnyvale outfall. The cessation of freshwater input will lead to an increase in salinity in Guadalupe Slough. However, due to the small volume of fresh water being diverted, the long-term impacts on wildlife in this slough may not be detectable. In addition, the freshwater source in the Sunnyvale oxidation ponds will continue to be a supplemental source to waterfowl breeding populations.

The vegetative community around the Palo Alto discharge channel has shifted somewhat to fresh water (Holmes, 1977), but the impacts of terminating freshwater flow into the channel will be minor compared to Artesian Slouth. The continual flushing of the channel would cease, and it would, with time, become a more typical south Bay tidal slough.

The discharge of treated effluent will have minor adverse impacts on the open water and mud flat habitats, since the discharge will be in deep water and diluted before the plume can affect mud flats and the open water column above the diffuser. These impacts will be a direct result of the quantity of effluent discharged, the lowering of the dissolved oxygen concentrations and the increased loading of toxic materials. The benthic communities within the sphere of influence of the discharge may be altered by the release of conservative (non-decaying) elements. The effluent is expected to have insignificant impacts on the planktonic and necktonic communities in the Lower Bay.

Most of the impacts on the benthic communities will result from the concentration of trace metals, oils and grease, and suspended matter from the effluent in the sediments. As discussed, these biological pollutants may be physically and/or biochemically extracted from the water. Over a period of time these natural processes will concentrate the pollutants within the sediments. If these concentrations are above species specific tolerance levels, certain species may be adversely affected. Some benthic species, including bateria, may be able to tolerate higher levels of trace metals, but they may also transmit these materials to non-adaptive predators, creating a substantial impact. When and if such an impact will occur cannot be predicted; monitoring the biota as proposed in the Bay Area monitoring program (SWRCB, 1977) may provide some insights as well as advance warning on this biological magnification of toxic material through the food chain. When these effects will occur will not be known for some time.

Recent EPA studies on heavy metals, chlorinated hydrocarbons, fecal coliform levels, and other wastewater toxicants in shellfish were described in the East Bay Dischargers Authority Draft EIS (1975c). In San Francisco Bay, fecal coliform and median total coliform mean probable number guidelines of the National Shellfish Sanitation Program (230 MPN/100 g and 70/100 ml, respectively) were exceeded in almost all stations in the Lower Bay; cadmium concentrations exceeded Food and Drug Administration standards (0.5 ppm) at two stations; and lead concentration standards were exceeded at two stations (7.0 mg/kg). Mercury concentrations and chlorinated hydrocarbons were within standards, and no standards have been established for chromium, copper, or zinc.

The impacts produced by effluent heavy metal on shellfish beds cannot be assessed except in general terms. Since the initial dilution achieved at the proposed discharge site is greater than those presently achieved in the South Bay, shellfish beds, in general, are not expected to be adversely affected by the metal concentrations from the Basin Plan outfall. However, as described earlier, shellfish may accumulate toxic materials, and this accumulation may occur at a faster rate as a result of the presence of wastewater and the resultant increase in toxic materials in sediments near the diffuser.

Un-ionized ammonia should not have an adverse impact, since dilution and oxidation is expected to result in conversion of any residual ammonia to less toxic nitrogen compounds such as nitrate.

Effluent discharges will have insignificant impacts on the organisms in open water habitat. With the release of the effluent from the diffuser, local eddies and/or other changes in hydrographic conditions within the discharge plume will occur. Those species capable of swimming will more than likely avoid the turbulent water "zone." Planktonic organisms on the other hand, may be temporarily entrained within the "zone" or pushed aside depending on the dynamics of the discharge plume.

Increases in nutrient levels at the discharge point as a result of nitrogen and phosphorus compounds in the effluent are not expected to result in algal blooms. In situ productivity studies in northern San Francisco

Bay (Roche, 1975) have shown that increases in algal productivity are more closely related to the initial chlorophyll *a* concentrations in the water than the initial inorganic nitrogen concentrations; i.e, natural nitrogen concentrations are "sufficiently high not to be reduced to a point that would significantly limit the growth rate during the 18-hour incubation period." In addition, Roche theorized that biological oxygen demand or toxic components in wastewater interfere with respiration rates of algae, reducing the net productivity.

An increase in algal productivity could occur should a "clear zone" result in the naturally turbid waters (Roche, 1975). A clear zone would result in an increased depth of penetration of sunlight. However, in the case of the Basin Plan Alternative, a clear zone from the release of clear sewage effluent would occur only near the diffuser in deep water. Surface water turbidity and the depth of penetration of sunlight should not be affected.

Oxygen demand levels in the South Bay sediments will decrease with time, with a corresponding increase in dissolved oxygen levels. As stated in Section II, the present dissolved oxygen levels are an important limiting factor in the South Bay environment. With an overall increase in the dissolved oxygen levels, more oxygen may become available to the benthic, planktonic, and nektonic organisms; of particular interest are the decomposing organisms (bacteria). With increased oxygen levels in the water and in the underlying sediments, potentially more detritus material will be decomposed and converted into particulate and suspended matter usable to the myriad invertebrates living on the mud flats. Although the future biological condition is speculative at this time, the increase in water quality within the open waters of the South Bay should have a beneficial effect on organisms in the open water and mud flat habitats, resulting in increased species diversity and species assemblages resembling those now occurring north of the Dumbarton Bridge.

The presence of the diffuser in the deep water north of Dumbarton Bridge will result in the presence of a mixing zone with salinities ranging from nearly freshwater to saltwater concentrations. While the mixing zone will not significantly affect the salinity of the open waters of the Bay, it may present a barrier to passage of fish not tolerant to salinity variations. Animals such as benthic species or plankton which may be exposed to the plume may, therefore, be adversely affected, while more mobile species may avoid the area. The location of this plume in the less rich, deep open water reduces the potential for adverse impact.

Social, Economic, and Cultural Environment

Operation of the Basin Plan Alternative and associated pumping facilities will impose minimal impacts on recreational and aesthetic resources and present and future land uses in the immediate vicinity of the pipeline route. Normal operation of the pipeline and associated facilities is not expected to affect the archaeological, paleontological, or historic resources in the study area. Significant operational impacts, however, might accrue to the economic structure of the study area as a result of financing necessary to operate and maintain the proposed project. A discussion of the operational impacts upon the economic structure of the study area is presented in Section III.3.

Recreational Uses of the Area. Operation of the Basin Plan Alternative will impose minimal restrictions on recreational and public use areas along the proposed alignment. These restrictions will be in the form of limiting development of lakes, small boat basins, and other projects requiring subgrade excavation within the project right-of-way.

Additional recreational impacts will occur from the loss of freshwater marsh areas, particularly in the vicinity of Artesian Slough. Discontinuation of freshwater discharge into the slough will cause saltwater intrusion and affect the composition of plant and wildlife in the marsh area, reducing the value of the area to bird watchers and other observers of biological phenomena.

Visual and Aesthetic Setting. Due to the subgrade location of the system, no operational impacts will occur along the land or water portions of the Basin Plan Alternative route. However, pumping station locations will impose some visual and aesthetic impacts on the surrounding area.

Should the San Jose/Santa Clara and Palo Alto pumping station be located within designated wastewater treatment areas near their respective treatment plants, as is now envisioned, these stations would not impose any significant adverse visual impacts on these designated industrial areas. The Sunnyvale pumping station, if located in the agricultural lands immediately south of the Caribbean Road, would impose temporary visual impacts in the area. However, the station could be designed to conform with the architecture of Moffett Industrial Park, thereby reducing the long-term visual impact imposed by the facility.

Increased noise levels created by the pumping stations may affect the aesthetic settings of the individual station locations, because, in general, an increase in noise renders an area less pleasing.

Present and Future Land Use. Operation of the Basin Plan Alternative will impose restrictions on land use within the project right-of-way. The right-of-way will remove approximately 66 acres of designated industrial and commercial lands from consideration for construction of buildings and other permanent structures.*

Energy Consumption. In 1980, approximately 7.88 x 10^6 kilowatt-hours per year will be committed to operation of the three pumping stations. This estimate is an average yearly consumption based on estimated 1980 flows (Section I.2.4), and is equivalent to the use of two 150-watt light bulbs, 24 hours a year, by each resident at Santa Clara County.

III.1.3 ECONOMIC IMPACT OF THE BASIN PLAN ALTERNATIVE

Introduction

This section presents the preliminary estimates of capital and operating costs, the distribution of these costs among SBDA service area dischargers, and the possible financial impacts associated with implementation of the Basin Plan Alternative.

The calculations of revenue requirements and user charges for SBDA member agencies and individual dischargers are presented for illustrative purposes and are not to be construed as final costs. Each SBDA member agency will prepare a financial plan for distribution of revenue requirements equitably among facility users. Substantial adjustments in revenue requirements presented in this section may occur upon completion of these final plans and programs.

The user charges imposed on SBDA service area dischargers and cost recovery requirements imposed specifically on industrial dischargers are not expected to create significant economic impacts. The current distribution of costs may impose greater economic impacts on specific high volume industrial dischargers in certain SBDA member agency areas; however, final redistribution of these costs could alleviate this potential inequity.

Study Assumptions and Methodology

Calculations of the capital and operating costs, distributions, and revenue requirements for the Basin Plan Alternative, and the associated financial economic impacts on residential, commercial, and industrial dischargers, have been derived in accordance with the California State Water Resources Control Board's *Revenue Program Guidelines for Wastewater Agencies*, September 1974. These guidelines incorporate federal, state, and industrial cost recovery regulations and guidelines and are intended to assist municipalities in developing and implementing appropriate revenue programs to assure adequate operation and maintenance and necessary replacement and expansion of treatment facilities.

---

*Based on approximately 36,000 feet of 80-foot right-of-way average within designated industrial-commercial lands.

In order to maintain comparability of data and to confine the study to preliminary revenue requirement determinations, certain assumptions were made in terms of discharge characteristics, financial positions, and policy decisions for the three participating agencies of the SBDA. Design capacity and annual flow volumes for San Jose/Santa Clara and Sunnyvale dischargers were compiled from 1974-1975 actual data. Palo Alto capacity and flow figures were taken from the March 1, 1974 *Financial Plan and Revenue Program* prepared by Bechtel Incorporated.

It is assumed that capital cost recovery for the project will be distributed among dischargers according to dry weather flow capacities, and operating and maintenance costs will be distributed according to annual volume flows. Policy decisions in the case of infiltration/inflow accommodations and credits, debt servicing, revenue requirement distributions, flow equalizations, and design adjustments have not been considered due to the numerous alternatives available to each participating agency. Depending on the applications of these policies, substantial adjustments in the revenue requirements, user charges, and industrial cost recovery figures presented in this section could occur.

Capital Costs. Table III-5 presents the total capital costs summary of the Basin Plan Alternative, as of January 1, 1978, broken down into the major component elements and escalated to January 1, 1980. The other costs, added to base capital costs of the pipeline and pumping stations, include a contingency allowance and other front-end costs, such as administrative, engineering, and design services. Costs of land easements and right-of-way are nonfundable under federal regulation. The escalation factor used to convert January 1, 1978 figures to January 1, 1980 was 7 percent compounded annually. January 1, 1980 is used as the midpoint of the construction phase of the project for

Table III-5

CAPITAL COST SUMMARY
($1,000's)

Total Capital Costs

	1/1/78 $	1/1/80(1) $	+ Other(2) Costs	Total
(1) Pipe Cost	47,410	54,280	10,499	64,779
(2) Pump Cost	14,231	16,293	3,151	19,444
(3) Total	61,641	70,573	13,650	84,223

Capital Cost Components and Shares

	Pipe	Pumps	Total
(4) 1/1/80 Cost	64,779	19,444	84,223
(5) Less Ineligible Costs @ 6.8%(3)	4,405	1,322	
(6) Eligible Costs	60,374	18,122	
(7) Federal and State Share (0.875)	52,827	15,857	68,684
(8) Local Share of Eligible Costs	7,547	2,265	
(9) Plus Ineligible Costs	4,405	1,322	
(10) Plus Nonfundable Costs(4)	1,900		
(11) Total Local Costs	13,852	3,587	17,439

Notes:

(1) January 1, 1978 capital costs have been escalated to January 1, 1980 (mid-point of construction) using 7% compounded annually.

(2) Excluding land, rights-of-way, and easements; including contingency allowance and costs for technical, legal, and administrative services.

(3) All ineligible costs are attributed to San Jose/Santa Clara.

(4) Nonfundable costs include land, rights-of-way, and easements.

convenience in computation. This mid-point date will be adjusted, should the Basin Plan Alternative be implemented, and calculations adjusted to account for inflation resulting since this analysis was completed.

Table III-5 also presents the division of capital costs into those portions borne by federal and state governments and those which will need to be supported from local funds. The total costs have been delineated into eligible and ineligible cost and into fundable and nonfundable costs. The amount of eligible costs (line 6) refers to the portion of project facilities qualifying for grant monies. This portion is derived from the amount of plant capacity needed to serve population growth for a specified period at a specified rate in relation to the total project facilities planned. Eligible capacity was determined to reflect 93.2 percent of the total capital cost. The entire amount of ineligible costs is allocated to San Jose/Santa Clara due to its excess capacity above that required by projected population growth. (The methodology for determination of this factor is presented in Appendix D of the *Financial Plan and Revenue Program Report*.) Nonrefundable costs (Line 10) include those costs for which federal and state grant monies will not be provided. For the proposed project, this includes the cost of land, rights-of-way, and easements.

Table III-6 shows the segregated capital costs by federal, state, and local shares and the distribution of these costs to the participating cities under the terms of the South Bay Dischargers Authority Joint Exercise of Powers Agreement. That agreement, providing the legal framework within which the authority operates,

---

Table III-6

DISTRIBUTION OF FEDERAL, STATE, AND LOCAL SHARES OF CAPITAL COST TO MEMBER CITIES ($1,000's, Constant 1980 Dollars)(1)

City (SBDA percent)	Local Share				Federal and State Share			Total Share
	Pipe(4)	Pumps	Total	% of Total	Pipe	Pumps	Total	
San Jose (81.507%)	8,336	2,215	10,551	(60.50)	26,536	7,966	34,502	45,053
Santa Clara (18.493%)	1,891	503	2,394	(13.73)	6,021	1,807	7,828	10,222
San Jose/Santa Clara (61.63%)(3)	10,227	2,718	12,945	74.23	32,557	9,773	42,330	55,275
Sunnyvale (22.58%)	2,133	511	2,645	15.16	11,929	3,580	15,509	18,154
Palo Alto (15.79%)	1,492	357	1,849	10.60	8,341	2,504	10,845	12,694
Total	13,852	3,586	17,439	100.00	52,827	15,857	68,684	86,123

Notes:

(1) Values may not add to totals due to rounding.

(2) Future policy decisions by SBDA may necessitate change in % shares and total cost distributions.

(3) San Jose/Santa Clara local share includes ineligible costs.

(4) Nonrefundable costs are included in pipe costs.

includes the provisions for distribution of Basin Plan Alternative costs. The agreement states that the initial capital outlay costs of the Basin Plan Alternative will be distributed among the cities in relation to the costs that would be incurred if each city separately provided the outfall necessary to dispose of its own effluent, expressed as a percent of the total of the costs that would be incurred by the three cities to separately make such provision, considering San Jose and Santa Clara as a single city. These single purpose conveyance costs were first estimated in the *Water Quality Management Plan for South San Francisco Bay* (Consoer-Bechtel, 1972). The costs were revised in the *Financial Plan and Revenue Program Report* (1974).

Operation and Maintenance Costs. The calculation of operation and maintenance cost allocations to each of the cities was derived in accordance with the provisions set forth in Joint Exercise of Power Agreement. Under the agreement "...administration, operation, maintenance and repair costs are to be borne by each city in the relation that its gallonage of effluent conveyed multiplied by the linear miles of pipeline through which its gallonage flows bears to the combined total gallon-miles of the three cities."

Costs of operation and maintenance of the Basin Plan Alternative were updated from Table 9-13 of the *Overview Facilities Management Plan* (Bechtel, 1974). Power costs have been reestimated to 1978/1979 values due to significant rate increases during the past few years. All component costs of operation and maintenance of the facility have been escalated at a compound annual rate of 8.5 percent to 1981/82, the assumed first year of facility operation. The 1981/82 estimated operation and maintenance cost is $321,000 of which $212,000 is the power cost component* and $109,000 is the maintenance and administration. Calculations of the cities' shares of the 1981/82 operation and maintenance costs are outlined in Table III-7. Annual flow volumes for 1974/75 for each of the cities were escalated to 1981/82 annual flow rates by compounding each individual city's average dry weather flow growth rate. The 1981/82 annual flow rates were then multiplied by the miles of joint outfall, through which each city's effluent will flow, to determine the percentage allocation of operation and maintenance cost to each city.

Computation of Allocation Factors

The procedure used to determine the capital cost, operation and maintenance cost, and interest cost allocation factor for each of the city dischargers was developed to conform with the SBDA Joint Powers Agreement and the State Revenue Guidelines.

Table III-7

ANNUAL FLOW VOLUMES OF CITIES
AND COMPUTATION OF
OPERATION AND MAINTENANCE COST SHARES

	Annual Flow Volume 1974/75 (million gal)	Growth Rate[1] ADWF	Annual Flow[2] Volume 1981/82 (million gal)	Miles	Million gal Miles	Percent
San Jose/ Santa Clara	31,358	2.33	36,005	15.51	558,438	81.9
Sunnyvale	6,025	0.94	6,373	11.34	72,270	10.6
Palo Alto	10,058	0.84	10,576	4.81	50,871	7.5
Total	47,442		52,954		681,579	100.0

Notes:
(1) Calculated from Table D-2, *Financial Plan and Revenue Program Report*, prepared for SBDA by Bechtel Incorporated, March 1, 1974.
(2) Escalated to 1981/82 at Compound Growth Rate of Average Dry Weather Flow.

---

*Power cost estimates assume 7.88 x 10^6 kWh per year will be committed at present rates, escalated to 1980 dollars, for the operation of the three pumping stations.

Table III-8 presents the computation of the five allocation factors used to estimate the annual revenue requirements of each of the three participating agencies and their individual dischargers. Grant and non-grant funded capital costs have been divided into pumping facility and outfall components. The grant funded portion of the outfall capital costs is treated separately because only that portion of outfall design capacity attributable to industrial dischargers need be recovered under the Federal Industrial Cost Recovery regulations. Consequently, this allocation factor is only charged to industrial dischargers in the service area. Interest costs are determined by assuming that each of the participating agencies will submit a bond issue in the amount of the total local share of capital costs. Alternative financing available to each agency will determine the final interest charges.

The operation and maintenance costs, escalated to 1981/82, have been multiplied by the city share factors presented in Table III-7, to arrive at the total annual operation and maintenance costs for each city. These costs are then divided by the projected 1981/82 annual flow volumes for each city to arrive at a unit cost per annual million gallons of flow.

The total unit allocation factors were then calculated by adding the five factors attributable to design capacity to arrive at a total per-unit design capacity allocation factor for each city. The per-unit annual flow allocation factor is also presented.

Table III-9 shows the calculation of annual revenue requirements for each of the member cities, and for the total project, using the allocation factors developed in Table III-8.

User Charges to Discharger Groups

The incremental amounts of user charges allocated to individual discharger groups in the four member cities have been analyzed and are presented in Tables III-10 through III-12. The groups are divided into residential, commercial, and industrial dischargers located within the boundaries of the four cities: San Jose, Santa Clara, Sunnyvale, and Palo Alto. This does not include those dischargers located in the tributary agency areas of San Jose/Santa Clara or Palo Alto. Each discharger group category will be presented and discussed with a detailed discussion of the industrial discharger category.

Residential Dischargers. Table III-10 presents the estimates of annual revenue requirements in each of the four cities. Comparable unit numbers, design capacities, and annual flow data were used to estimate the comparable 1981/1982 average revenue requirements in each city. The annual revenue requirement for each city represents the revenue derived from those residences existing in 1974/1975. As the number of residents increases, the annual revenue requirement in 1981/1982 for residential dischargers is expected to be reduced.

Commercial Dischargers. Table III-11 presents the estimated annual revenue requirements for commercial dischargers in the four representative cities. Additionally, two individual commercial groups, restaurants and domestic laundries, are presented to illustrate the average annual user charges of these establishments in their respective city locations.

Industrial Dischargers. The analysis of industrial dischargers has been structured to present both the direct impacts of annual revenue requirements on the industrial group and secondary impacts and the effects of annual revenue requirements on an individual industry.

The industrial discharger direct impact analysis has been broken down into a broad analysis of all industries in the representative cities, with the electrical and electronic machinery equipment and supply industry

Table III-8

COMPUTATION OF ALLOCATION FACTORS AND USER CHARGES(1)
($1,000's, except Operation and Maintenance)

	San Jose/Santa Clara					Sunnyvale					Palo Alto				
	Capital Costs ($)	Useful Life (years)	Annual Cost ($)	Total mgd Design Capacity	$ Charge per mgd of Design Capacity	Capital Costs ($)	Useful Life (years)	Annual Cost ($)	Total mgd Design Capacity	$ Charge per mgd of Design Capacity	Capital Costs ($)	Useful Life (years)	Annual Cost ($)	Total mgd Design Capacity	$ Charge per mgd of Design Capacity
Capital Cost - Grant Funded Facilities															
Pumping Stations -															
Equipment	6,841	20	342			2,506	20	125.3			1,753	20	87.65		
Structures	2,932	40	72			1,074	40	26.95			751	40	18.78		
Total	9,773		415	143	2.902	3,580		152.25	22.5	6.762	2,504		106.43	35	3.041
Capital Costs - Non-Grant Funded Facilities															
Pumping Stations															
Equipment	1,903	20	95.1			358	20	17.9			251	20	12.5		
Structures	815	40	20.4			153	40	3.8			107	40	2.7		
Total	2,718		115.5			511		21.7			358		15.2		
Outfall - (Non-Grant Funded)	10,227	30	340.9			2,133	30	71.1			1,492	30	49.7		1.853
Total	12,945		456.4	143	3.192	2,644		92.8	22.5	4.124	1,850		64.9	35	
Grant Funded Outfall Capital Costs															
City Portion ($)			27,906					10,224					7,150		
Useful Life (years)			30					30					30		
Annual Cost ($)			930.212					340.8					238.326		
Total mgd Design Capacity			143					22.5					35		
$ Charge per mgd of Design Capacity			6.505					15.147					6,809		
Interest Cost (1981/2)															
Non-Grant Funded Facilities ($)			12,945					2,644					1,850		
Total 1981/82 Interest Cost(2) ($)			906.15					185.08					129.5		
Design Capacity (mgd)			143					22.5					35		
$ Charge per mgd of Design Capacity			6.337					8.226					3.700		
Operation and Maintenance Costs (1981/82)(3)															
Costs ($)			321					321					321		
City Percentage			0.819					0.106					0.075		
City Operation and Maintenance Annual Cost			262.899					34.026					24.075		
1981/82 Annual Flow			36,005					6,375					10,576		
$ Charge per mgd of Design Capacity			7.302					5.337					2.276		
Allocation Factor															
Capital Costs per mgd ($)			18.936					34.259					15.403		
Operation and Maintenance Costs per mg (actual dollars)			7.30					5.34					2.28		

Notes:

(1) Individual agency allocation factors and user charges might fluctuate depending upon policy decisions by the agencies or SBDA.

(2) Assumes no principal payments until 1981/1982.

(3) Charge per million gallons of annual flow in actual dollar values.

Table III-9

ALLOCATION FACTORS AND TOTAL ANNUAL REVENUE REQUIREMENTS FOR SAN JOSE/SANTA CLARA, SUNNYVALE, AND PALO ALTO

(First Year of Operation – 1981/1982)

	San Jose/ Santa Clara(1)	Industrial Share	Sunnyvale	Industrial Share	Palo Alto	Industrial Share	Total System	Industrial Share
(1) Design Capacity (mgd)	143.0	36.1	22.5	10.2	35.0	8.7	200.5	55.0
(2) Annual Flow (1981/82) (mg)	36,005		6,375		10,576		52,956	
(3) Capital Cost Grant Factor ($)	2,902		6,762		3,041			
(4) Capital Cost Non-Grant Factor ($)	3,192		4,124		1,853			
(5) Capital Cost Grant Outfall Factor ($)		6,505		15,147		6,809		
(6) Operation and Maintenance Cost Factor ($)	7.30		5.34		2.28			
(7) 1981/1982 Interest Cost Factor	6,337		8,226		3,700			
(8) Annual Cost Grant (1x3)($)	414,986		152,145		106,435		673,566	
(9) Annual Cost Non-Grant (1x4)($)	456,456		92,790		64,855		614,101	
(10) Annual Cost Grant (1x5)(2) ($)		234,830		154,499		59,238		448,567
(11) 1981/1982 Operating and Maintenance Cost (2x6)($)	262,836		34,042		24,113		320,991	
(12) 1981/1982 Interest Cost (1x7)($)	906,191		185,085		129,500		1,220,776	
Total Annual Revenue Required (1981/1982)($) (lines 8+9+10+11+12)	2,275,299		618,561		384,141		3,278,001	

Notes:

(1) Outfall: grant funded capital costs are allocated only to industrial design capacity.

(2) Industry agency industrial shares and capacity allocations may change due to policy decisions made during preparation of final revenue programs by the agencies or SBDA.

Table III-10

ANNUAL REVENUE REQUIREMENT
AND AVERAGE USER CHARGE
TO RESIDENTIAL DISCHARGERS IN SAN JOSE,
SANTA CLARA, SUNNYVALE, AND PALO ALTO

	San Jose	Santa Clara	Sunny-vale	Palo Alto
Number of Users 1974/1975	169,011	31,414	36,650	22,150
Design Capacity (mgd)	34.109	7.005	8.600	5.270
Annual Flow (mg)	12,449.8	2,556.8	3,150.0	1,923.0
Annual Revenue Requirement ($)	514,892	105,744	181,184	49,674
1981/1982 Average User Charge per Residence ($) for Implementation of Basin Plan Alternative	3.05	3.37	4.94	2.24

and the canned fruit and vegetable industry utilized as representative high flow industries. The secondary impact analysis utilizes the canned fruit and vegetable industry for predicting possible secondary economic impacts on a high flow industry resulting from the revenue requirements of the Basin Plan Alternative.

Table III-11

ANNUAL AND AVERAGE ANNUAL
REVENUE REQUIREMENTS
FOR COMMERCIAL ESTABLISHMENTS
IN SAN JOSE, SANTA CLARA, SUNNYVALE,
AND PALO ALTO

City and Category	Design Capacity Flow (mgd)	Annual Flow (mg)	1981/1982 Annual Revenue Requirement ($)
San Jose –			
Total Commercial	11.795	3,082.7	169,128
Restaurant	0.739	269.7	11,156
Domestic Laundry	0.370	93.6	5,282
Santa Clara –			
Total Commercial	4.979	1,420.7	72,265
Restaurant	0.654	238.7	9,873
Domestic Laundry	0.029	7.6	415
Sunnyvale –			
Total Commercial	2.400	693.5	49,572
Restaurant	0.202	73.7	4,255
Domestic Laundry	0.083	30.3	1,748
Palo Alto –			
Total Commercial(1)	2.580	655.0	23,666
Restaurant	0.170	53.0	1,582

Note:
(1) Domestic laundry data and total commercial data for Palo Alto were not available at time of publication.

Direct Impact on Industrial Dischargers. Each year during the industrial cost recovery period of 30 years, as stated in the State Revenue Guidelines, each industrial user of the joint outfall will pay its share of the total amount of the grant allocated to the municipality in which the industry is located. An industrial user's share is based on flow rates such that a proportional share of grant assistance allocable to industrial use of the outfall is recovered.

As stated, the federal portion of the capital costs for the Basin Plan Alternative attributable to industry are recovered from industrial dischargers but not from others. As a result, the industrial dischargers in the four cities pay approximately 60 percent more per million gallons per day of design capacity than do residential and commercial dischargers.

Table III-12 shows the distribution of 1981/82 annual revenue requirements to industrial dischargers in the representative cities. Also, calculations for the electronics and canned fruit and vegetable industry are presented.

Analysis of the Canned Fruit and Vegetable Industry

The canned fruit and vegetable industry was selected as representative due to its high flow characteristics, the potential for incurring high revenue requirements, and concern expressed by industrial representatives. Financial and employment data for this analysis were compiled through a survey distributed to SBDA service area canning plants. With the cooperation of the Santa Clara County Canners Association, detailed information on approximately 50 percent of the plants was collected for the 6-year period of 1970 through 1975.

A brief discussion of the canned fruit and vegetable industry structural characteristics is presented, together with the methodology and conclusions of the analysis.

Industry Characteristics. The analysis was restricted to the canned fruit and vegetable processing industry located within the SBDA service area. A total of 15 plants are located in San Jose, Santa Clara, and Sunnyvale, while no plants are located in Palo Alto.

Table III-12

ANNUAL REVENUE REQUIREMENTS
FOR INDUSTRIAL DISCHARGERS
IN SAN JOSE, SANTA CLARA,
SUNNYVALE, AND PALO ALTO(1)

City/Industry	Design Capacity Flow (mgd)	Annual Flow (mg)	1981/1982 Annual Revenue Requirement ($)
San Jose			
Total Industrial	31.601	3,929.626	627,083
Electrical Manufacturers	0.203	51.324	4,219
Canners	20.782	1,911.262	407,480
Santa Clara			
Total Industrial	2.524	773.3	53,439
Electrical Manufacturers	0.984	322.1	20,984
Canners	0.530	89.7	10,691
Sunnyvale			
Total Industrial	10.2	1,155.8	355,614
Electrical Manufacturers	2.774	740.7	98,989
Canners	3.250	159.8	112,195
Palo Alto			
Total Industrial	5.221	1,332.4	83,457
Electrical Manufacturers	2.292	581.9	35,437
Canners	0	0	0

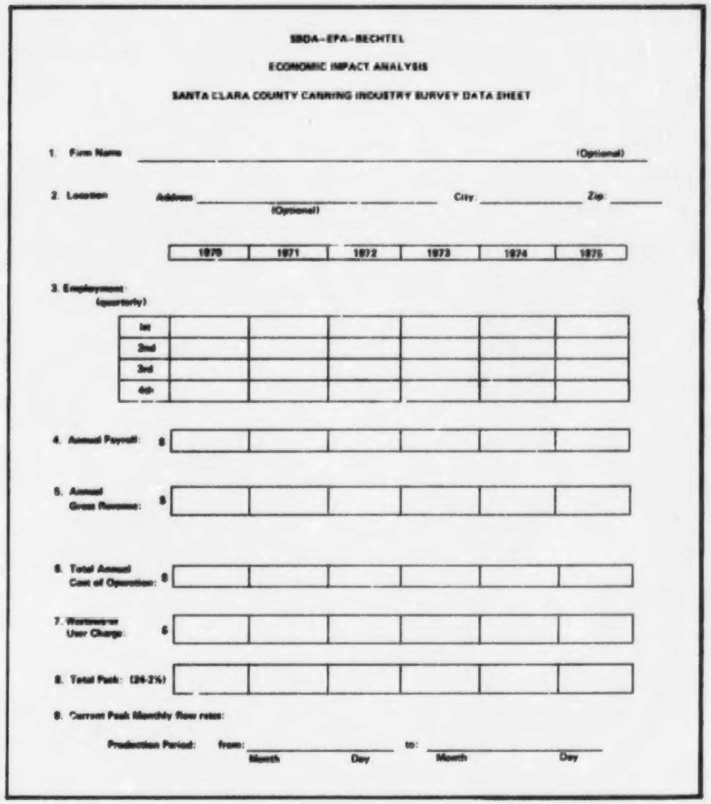
Note:

(1) Industrial annual revenue requirements might change depending on policy decisions by SBDA and participating agencies.

Location of plants is dependent on the supply of raw materials for processing. The development of agricultural production in the Santa Clara Valley was a large determinant for the growth of the canning industry in the area.

The demand for canned fruits and vegetables has increased over the past 25 years, with an increase in per-capita consumption from 43 pounds in 1950 to 67 pounds in 1970 for fruits and from 83 pounds in 1950 to 115 pounds in 1970 for vegetables. However, the rate of increase over the past 5 years has declined due to a number of factors. Exogenous economic factors related to production labor and raw material costs and corresponding revenue requirements have contributed to this decline. The industry annual price increase grew from 2.83 percent in 1970/1971 to 13.87 percent in 1973/1974. In response to the corresponding increased price for fruit and vegetables, consumers are substituting fresh and home grown products for canned fruits and vegetables. Prices of products also fluctuate from year to year in response to annual production totals and year-end stock carryover.

A total of eight plants supplied data for the analysis by completing the survey form shown in Figure III-4. Plant sizes, based on average number of cases packed, ranged from approximately 450,000 cases per year to 6,500,000 cases per year over the 6-year study period. Total employment at the surveyed plants amounted to approximately 6,000 in 1975. This represents about 60 percent of the total canning and preserving industry employment in Santa Clara County. The 1975 payroll for employees of the plants surveyed was estimated to be $33 million with an eight-plant 1975 total annual revenue of $256 million.



SBDA-EPA-BECHTEL

ECONOMIC IMPACT ANALYSIS

SANTA CLARA COUNTY CANNING INDUSTRY SURVEY DATA SHEET

1. Firm Name ______________________ (Optional)

2. Location Address ______________ (Optional) City: __________ Zip: ______

	1970	1971	1972	1973	1974	1975
3. Employment: (quarterly) 1st						
2nd						
3rd						
4th						
4. Annual Payroll: $						
5. Annual Gross Revenue: $						
6. Total Annual Cost of Operation: $						
7. Wastewater User Charge: $						
8. Total Pack: (24-2½)						

9. Current Peak Monthly flow rates:

Production Period: from: ______ Month ______ Day to: ______ Month ______ Day

Figure III-4 SBDA-EPA-BECHTEL
ECONOMIC IMPACT ANALYSIS
SANTA CLARA COUNTY CANNING INDUSTRY
SURVEY DATA SHEET

Methodology. The methodology used in the industry analysis was structured to estimate the revenue requirements of the surveyed plants needed to recover the 1981/1982 user charges imposed by the Basin Plan Alternative. Survey data were adjusted from current 1970 through 1975 dollar values to 1975 dollars using the U.S. Department of Commerce implicit price deflator for nondurable goods. Annual revenue and cost of operation data were then projected for the years 1976 through 1981/82, using a 7 percent escalation rate. Average annual revenues and cost of operation values were then calculated for each plant in order to account for year-to-year fluctuations in these values and to provide comparable values between plants.

The projected average revenue and cost of operation values were then plotted using least squares regression to illustrate the relationship of revenues and cost of operation to size of plant. Assuming that the relative size between plants does not change between 1975 and 1981/82, Figure III-5 shows the relation between size of plant, gross revenues, and cost of operation.

Assuming that the area between the gross revenue line and cost of operation line in Figure III-5 represents before-tax gross margin, 1981/82 user charge and industrial cost requirements for each plant could be added to cost of operation figures. This produces an estimated reduction in gross margin equal to the user charge imposed by the proposed project. In order for each plant to recover this decrease in margin, gross revenues would have to be increased by an amount equal to the user charge imposed upon each plant.

Conclusions of the Analysis. Analysis of the relationship of requirements to gross margin for the surveyed plants produces an average requirement of $35,357 imposed upon an average gross margin of $3.254 million in 1981/82. This user charge represents approximately 1 percent of the average gross margin. Among the individual plants, user charge requirements range from 0.3 percent to 1.3 percent of gross margin, with one plant paying 1.5 percent of gross margin.

The effect of 1981/1982 requirements for the Basin Plan Alternative on individual plants is not expected to be significant based on this analysis.

Conclusions

Implementation of user charges required to recover capital and operating costs in the Basin Plan Alternative may impose negative economic impacts in the form of locational adjustments to high flow industrial plants, particularly plants involved in the canned fruit and vegetable industry. Significant economic impacts are not expected to be imposed on residential and commercial dischargers due to the relatively small user charge. An outfall project alone would not impose significant economic cost to individual users or industries. However, further analysis of final outfall user charges together with user charges for advanced waste treatment should be made in order to assess the combined economic impact.

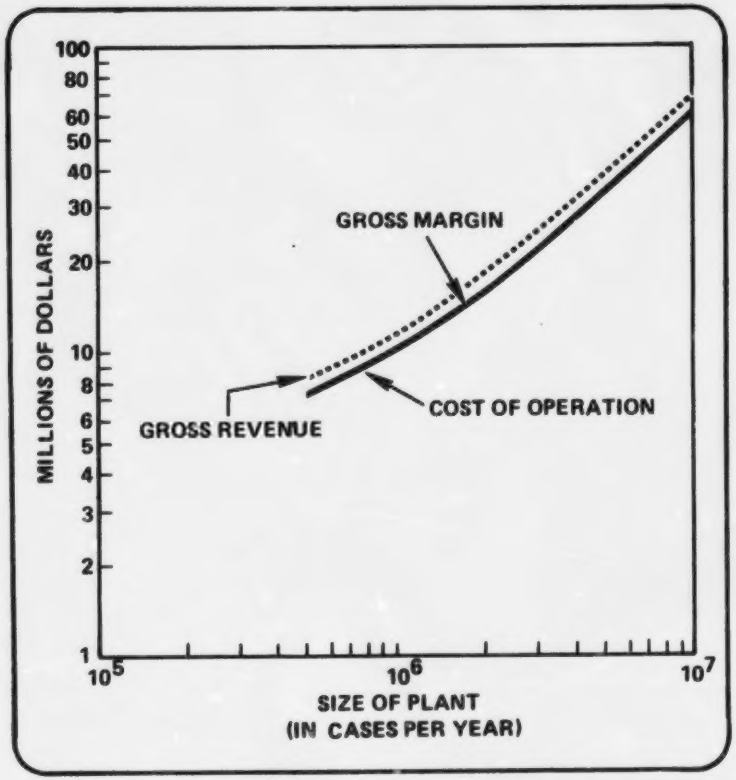


Figure III-5
SURVEYED CANNED FRUIT AND VEGETABLE INDUSTRY
GROSS REVENUE, COST OF OPERATION
(PROJECTED 1981/82)

III.1.4 ACCIDENT OR NATURAL CATASTROPHE

Natural hazards characteristic of the South Bay region are related to the geology and seismicity of the area. The project is in an area subject to saltwater flooding in the event of levee failure and potentially subject to earthquake damage (see Sections II.1.1 and II.1.2 for discussion of these problems). These hazards, as well as malfunctions of project equipment, could result in accidents that, in turn, would contribute to various pollution levels in the environment.

Flooding

The pipeline and outfall components of the Basin Plan Alternative would not be affected by flooding. However, inundation of treatment facilities or pumping stations could affect the quality of the effluent being discharged. Each treatment plant is protected by levees at the present time. However, in the event of levee failure at any one plant, discharge of untreated or partially treated wastes is possible. These wastes would likely be discharged into the South Bay, bypassing the Basin Plan conveyance systems. In the event that the levee failure occurred between Stations 22 and 18, where the conveyance is located within the levee system, some structural damage to the pipeline might also occur. Again, wastewater would be discharged into the South Bay. Impacts on the South Bay would vary with the quality of the wastewater, but in general, a release of treated wastewater from a damaged conveyance system would result in locally depressed dissolved oxygen levels and increases in levels of toxic materials (see also Section II.1.2).

Levee failure or saltwater flooding as a result of high tides or wind driven water overtopping levees is currently intensified by the problem of subsidence in low-lying Baylands (Tudor Engineers, 1973). Current improvements to the levee system, such as the upgrading of levees at Mountain View Regional Shoreline Park, reduce the likelihood of damage to the project from flooding. Additional proposals by the Santa Clara Valley Water District to implement a system of inboard and/or outboard dikes will, if approved, further reduce the probability of damage due to flooding.

Earthquake

A major earthquake in the Bay Area could have an impact on pipeline and pumping stations. Lurch or slide movements of Bay Mud, for example, could affect pipeline integrity. The Basin Plan pipeline alignment, however, has been selected to avoid areas of soft mud, and the pipeline and pumping stations will be placed on stiff clays underlying the mud or on pilings. These precautions and proposed backfill techniques (Section I) are expected to provide adequate protection to the project for all but devastating earthquake forces. Again, in the unlikely event of system failure, discharge of wastewater to the South Bay is possible. Local, short-term water quality and biological impacts would result, lasting until repairs could be made.

Plant Upset

Treatment plant malfunctions could cause overflows of incompletely treated wastewater into the conveyance system. At the Basin Plan Alternative disposal point, water quality degradation, including increased oxygen demand, increased levels of nutrients and toxicants, and increased suspended solids, would occur. This degradation would be short-term, lasting only as long as the plant upset. However, secondary impacts on sediment quality and biota could be expected to persist, requiring several months or more for recovery.

In the event of a plant upset, there is some storage capacity in the treatment plant at Sunnyvale, where bypassed flows could be stored. However, this capacity is limited and does not provide protection for plant upset at Palo Alto. Therefore, the potential for adverse impact on water and sediment quality and biota is high in the event of electrical power failure or other causes at any one of the treatment plants.

Pumping Station Malfunction

Pumping station malfunctions due to electrical power failure or pump breakdown could require bypass of the Basin Plan conveyance system, discharging treated wastewater flows to the South Bay. Depending on the location of the failure, these quantities of bypassed flows could have an adverse impact. In general, such a bypass would affect water quality in the same fashion as the no further action alternative should the bypass occur at the San Jose/Santa Clara pumping station (Section III.1.2, Figure III-1). Similar impacts could also occur at the Sunnyvale or Palo Alto pumping plants, although the quantities discharged at these locations would be greater than present discharges. In the event that malfunction did occur, the local impact on water quality would be less than in the event of treatment plant upset.

Should the malfunction require extensive replacement of pumps or parts, the length of time necessary to remedy the bypass could range from six months to a year. In this event, the long-term improvement in South Bay water quality could be significantly inhibited. Standby pumps at each pumping station and dual power supplies (see Section I.1.3) at each treatment plant would be provided to minimize the potential for station malfunction.

III.2

UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Section III.1 identified significant adverse environmental impacts that might result from the Basin Plan Alternative. All of the environmental impacts of the Basin Plan Alternative are direct consequences of SBDA attempts to ameliorate the current environmental impacts on water quality of discharging wastewater south of Dumbarton Bridge. At present, it is not possible for SBDA to satisfy the requirement prohibiting the discharge south of Dumbarton Bridge or to dead-end sloughs without incurring the environmental impacts attendant in the construction and operation of new conveyance facilities.

As described, the Basin Plan Alternative will have an unavoidable adverse impact primarily during the construction phase and, to a lesser extent, during operation. This section discusses the significant unavoidable adverse impacts associated with the Basin Plan Alternative.

III.2.1 ADVERSE CONSTRUCTION EFFECTS

Physical Environment

Land surface disturbance along the pipeline alignment will be the principal impact on terrain.

Short-term localized adverse impacts on air quality will result from the construction equipment engine exhaust emissions, generation of fugitive dust, and possible release of odorous compounds such as hydrogen sulfide and mercaptans from the excavation of anaerobic sediments.

Excavation activities that cross existing streams will increase turbidity, nutrients, and chemical pollutants in the water. Dredging activities in the estuarine portion of the alignment will diminish water quality by significantly increasing concentrations of suspended solids and the turbidity, oxygen demand, and chemical pollutants. These effects will be temporary, decreasing as the turbidity plume and suspended solids disperse and settle out.

Noise levels generated during construction activities that use compressors, pile drivers, cranes, and other heavy construction equipment will exceed specified city codes for limited periods of time.

Biological Environment

A number of biologically sensitive areas, including salt marshes, mud flats, and salt pond dikes, will be unavoidably disturbed.

Excavation in the marshes will temporarily have an adverse impact on two endangered species — the California clapper rail and the salt marsh harvest mouse — by reducing the amount of habitat available to them and by increased noise and human activity near the marshes.

Dust and noise will be generated throughout most of the construction area. In more sensitive wildlife areas, unavoidable displacement of birds and mammals occupying those areas may occur as well as in other areas on either side of the alignment. However, the short-term duration of construction activities should permit the restoration of preconstruction conditions after four to five years (with natural revegetation) at most.

Dredging operations will permanently displace epifauna species such as polychaete worms *(Streblospia benedicti, Asychis elongata)*, bivalve molluscs *(Modiolus senhousia, Gemma gemma*, and *Macoma inguinata)*, and oligochaete worms *(Peloscolex apectinatus)* as well as all of the infauna. While the loss of such populations in the dredged area will be virtually complete, the area should gradually become repopulated with the same species as displaced or with new species capable of living within the type of substratum used to backfill the dredged trench.

Social, Economic, and Cultural Environment

Significant adverse impacts on the population and the demographic characteristics of the area are not anticipated during construction activities. Capital costs for construction of the project, as described in Section III.1.3, and loss of agricultural production, estimated at a maximum of $103,200, are the main adverse economic impacts.

During construction of the pipeline, access to various recreation areas will be limited. Additionally, during dredging, temporary restrictions will be placed on navigation between the Palo Alto Yacht Harbor and San Francisco Bay. Such adverse recreational impacts will be temporary and limited to specific areas.

Adverse impacts on the aesthetics of the project area will result from construction activity, noise, and possible odors or dust generated during trenching.

Excavation activities may inadvertently destroy valuable archaeological, paleontological, or historical resources. Even with proper monitoring of the excavation sites, it is possible that permanent destruction of valuable sites could occur.

III.2.2 ADVERSE OPERATIONAL EFFECTS

Physical Environment

Discontinuing a significant portion of the freshwater inflow into the South Bay will permanently remove the existing freshwater habitat in the area south of Dumbarton Bridge.

Adverse impacts on water and sediment quality will occur at the Basin Plan Alternative disposal point. Decreases in dissolved oxygen and increases in nutrients, toxicants (including heavy metals), and coliform bacteria are expected to occur, with some degradation of water and sediment quality at the discharge point. In portions of Artesian and Guadalupe Sloughs, dissolved oxygen levels will be low, reflecting natural background oxygen demand and decreased flushing in the sloughs.

Biological Environment

The adverse biological impacts will occur in Artesian Slough and in open water habitats, as the South Bay returns to a predominantly saline condition. During this transition period, segments of the entire slough system will become anaerobic perhaps for months at a time. The consequent change in wildlife habitat will eliminate roosting and nesting places for freshwater marsh birds and mammals. Until this ecological system reestablishes as a saltwater habitat, its value to wildlife will be significantly reduced from its present level. Loss of freshwater habitat will result in a permanent reduction in habitat diversity in the National Wildlife Refuge.

Discharge of the treated wastewater north of Dumbarton Bridge will adversely affect existing benthic communities near the discharge area to an unknown extent. Much of this impact will result from the discharge and buildup in the sediments of trace metals, oil and grease, and suspended solids.

Social, Economic, and Cultural Environment

No significantly adverse social or cultural impact has been identified as attributable to operation of the proposed project.

Adverse economic impacts include an annual revenue requirement from wastewater dischargers of $321,000 (in 1981/1982) to cover operation and maintenance of the proposed project. In addition, 7.88×10^6 kilowatt-hours per year will be committed to power consumption for operation of the three pumping stations. The power cost amounts to $212,000 of the total $321,000 operation and maintenance cost in 1981/1982.

III.3

MITIGATION MEASURES

As discussed in Section III.1, construction and operation of the Basin Plan Alternative will have both beneficial and adverse effects on the baseline environment. The construction program and environmental protection measures incorporated into the engineering design will mitigate most of the adverse environmental effects, except the unavoidable adverse effects described in Section III.2.

This section presents mitigation measures to minimize impacts during both construction and operation. Further contingency mitigation measures, planned to minimize any unforeseen impacts that may occur during construction and operation, are described.

Briefly, the mitigation measures discussed fall into one of two classes:

- Proposed measures. Measures that have been implemented in planning and conceptual design phases or that will be implemented in design, construction, or operation phases.
- Potential measures. Measures that could be implemented in design, construction, or operation phases of the project to reduce impacts.

III.3.1 MITIGATION OF CONSTRUCTION IMPACTS

Proposed Measures

Land surface disturbance will be minimized by removing excess spoil to a suitable landfill site. After completion of construction activities, revegetation and stabilization of the construction area will eliminate the probability of continuing erosion. Surface runoff will be channelized into temporary holding ponds for percolation and/or evaporation. Prior to the removal of excess spoils, the spoils piles will be carefully located to minimize disturbance to the sensitive habitat in the salt marshes, mud flats, and salt pond dikes.

Excavation and earth moving will unavoidably generate fugitive dust on windy or gusty days. Use of dust abatement measures, such as wetting spoils with water, will control these emissions to a large extent. The impact of load spills and wheel mud will be minimized by regular maintenance of local public roadways.

During construction, bulkheading will be used to protect streams from construction activities. Bulkheads will be placed on both sides of the alignment, and the stream or slough will be temporarily culverted to allow continued tidal exchange and stream drainage. Upon completion of the stream crossing, bulkheads and culverts will be removed. Stream banks will be restored to near-original condition, using grading, rip-rap, and revegetation programs to stabilize bank conditions.

Unavoidable noise will be generated by the operation of bulldozers, cranes, compressors, and other construction equipment. Pile driving will be the major noise source during construction of the submerged pipeline section. Although construction noise in any given location will occur for only a limited period of time, effective use of noise reduction mufflers on all equipment with internal combustion engines, scheduling of construction within noise sensitive areas to occur within normal working hours, and other similar noise abatement programs will be instituted to mitigate noise impacts.

The construction of the Basin Plan conveyance system will disturb a number of biologically sensitive areas. In these sensitive terrestrial habitats, the impact can be partially mitigated by narrowing the 150-foot normal working area to 60 feet. This measure will be implemented at the marsh near Eldorado Street (Station 6), Alviso marsh (Station 7), the marsh in the dry field near Saratoga Creek (Station 8), and the Palo Alto water quality control plant discharge canal (Stations 58 to 60).

Excavation of the pipeline trench through the Baylands will temporarily reduce the amount of habitat potentially available to two endangered species, the California clapper rail and the salt marsh harvest mouse, as well as the rare Alameda song sparrow and other species of special concern in the Baylands (burrowing owls, raptors, and wading birds). These impacts will be mitigated partially by careful construction scheduling (i.e., avoiding primary nesting period of the clapper rail and Alameda song sparrow of mid-May through June, near Palo Alto) and proper restoration programs for the marsh areas and channel bottom contours.

Revegetation programs will be implemented in sensitive biological habitats; these include the areas described above (Stations 6, 7, 8, 48-51, and 58-60). An expert in marsh revegetation will be engaged to develop and implement a reseeding or replanting program. In other areas, such as grasslands, reseeding of the right-of-way following backfill and surface compaction will be a part of the normal cleanup program. No spoils piles will be left on the site; excess spoils will be disposed of at an approved landfill.

Visual and aesthetic impacts will be mitigated by the planned construction program of excavating, laying the pipe, and immediately backfilling along the right-of-way, minimizing construction time in any one location. Upon completion of construction, the disturbed area will be restored to its preconstruction condition.

Disruption of traffic flow at four major road crossings, restricted access to several public use areas, and temporary restriction of operations at Palo Alto Airport will result from the construction activity. The traffic-related impacts will be substantially mitigated by:

- Implementing the planned construction program of immediately backfilling as the pipeline is put in place

- Providing temporary vehicle and pedestrian bridges over the trenchways
- Maintaining close liaison with city and county traffic control officials to assure as smooth a traffic flow as possible
- Instructing all subcontractors to use predesignated routes to and from the construction sites and to operate haul vehicles during off-peak traffic time periods, whenever possible.

Excavation activities may uncover archaeological, paleontological, or historically valuable resources and artifacts. In order to mitigate the likely destruction of such sites and landmarks, a qualified archaeologist will be retained to inspect the final alignment prior to excavation and report on the discovery of any valuable sites. Any valuable uncovering will be either removed or preserved. For all ground disturbance where inspections have indicated a reasonable probability of effect on cultural resources, an archaeologist will be present. This person will have the authority to stop construction while the State Historic Preservation Officer is consulted. Project work will be shifted during this period to less sensitive areas.

Temporary elimination of production on approximately 60 acres of agricultural land will cause an unavoidable loss in wages and salaries to laborers and proprietors in the agriculture sector of the economy, amounting to a maximum of approximately $103,200. Scheduling the construction during the nonproduction season should minimize the impact. Topsoil will be stockpiled during construction, and agricultural fields will be restored, using this topsoil, according to the contracted agreements with the property owners.

Construction safety programs will be implemented at the construction site to protect excavation workers from potentially harmful exposure to hydrogen sulfide and methane, should these gases be released during excavation.

Potential Measures

Impacts on water quality can be the most damaging at stream crossings where the trenches for the pipeline will be open. Careful scheduling of the construction work for the drier summer months of the year will minimize the potential for increased turbidity, nutrients, and pollutant levels in waterways, although it will not be completely eliminated.

During dredging operations, finer fractions of sediment will likely escape from the dredging equipment and create a turbidity plume that will settle on those organisms living within the interface between the water and sedimentary layers. A potential mitigation measure is the use of floats and screens to minimize the amount of sedimentary material that settles out of the dredging. However, since these impacts are of such a short-term nature and relatively minor, it may not be economical to attempt their mitigation, and this approach is not currently contemplated.

By emplacing sheet pilings along the right-of-way, excavating, laying pipe, and backfilling can be accomplished in a narrower construction easement. The surface width of the trench can be reduced below the 60-100 foot sizes described in Section I.2, and surface disturbance can be significantly reduced without the possibility of collapse of the trench walls. This method may be used in sensitive areas such as marshlands or other biological habitats to reduce habitat loss.

Construction noise levels may violate recommended levels in each of the communities of Sunnyvale, Mountain View, and Palo Alto. This noise violation may be attributed, primarily, to pile driving activities. The equipment chosen for pile driving could mitigate noise levels; there are, for example, "quiet" pile drivers that use compressed air to lift and cushion the piston, reducing noise of metal-to-metal impact to 73 dB(A) or better at 80 feet.

III.3.2 MITIGATION OF OPERATION IMPACTS

Proposed Measures

Plans to enclose the Sunnyvale pumping station, using a design that is architecturally consistent with the Moffett Industrial Park requirements, will mitigate any aesthetic impact of the station. Similarly, noise impacts from the pumps will be minimized by the enclosure of the pumping stations at both Sunnyvale and Palo Alto. Enclosure design will be a phase of detailed project design. In addition, all three pumping stations will be landscaped.

Potential Measures

During operation, several hundred cubic feet per second of freshwater inflow will be diverted from the South Bay to the Lower Bay north of Dumbarton Bridge. Removal of a significant portion of the freshwater discharges south of the Dumbarton Bridge will transform the slough areas into a brackish or saline backwater condition. The most drastic alteration in water quality will occur in Artesian Slough where freshwater habitats are currently artificially maintained by the wastewater discharge. During the transition, freshwater habitat will deteriorate and be replaced by salt tolerant forms. Mitigation of such transitional impacts by redirecting storm drainage or by providing an alternative source of fresh water into these freshwater habitats would be expensive. Also, the seasonality of the storm drainage would not allow year-round maintenance of freshwater habitat in the sloughs. However, in areas of particular biological concern, such as the freshwater marsh on Artesian Slough and in nearby New Chicago Marsh, some freshwater flow augmentation could contribute to maintaining habitat diversity in the wildlife refuge. Such flow augmentation is a potential local reuse of reclaimed wastewater. However, there are no current reclamation plans that would be implemented prior to removal of the discharge.

Local degradation of water and sediment quality will occur at the new disposal point. However, the rate and magnitude buildup of heavy metals, chlorinated hydrocarbons, and other toxicants in the sediments in the disposal area can be mitigated to some extent with source control. This measure is currently under study by all members of the SBDA.

III.4

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

III.4.1 SHORT-TERM USES OF MAN'S ENVIRONMENT

Construction of a conveyance from the South Bay Dischargers Authority treatment plants to a disposal point north of Dumbarton Bridge constitutes a short-term use of the local environment. Short-term alteration of land surfaces with attendant local degradation of air and water quality, ambient noise levels, and biological communities will occur. These impacts have been discussed in detail in Section III.1, and the unavoidable adverse impacts summarized in Section III.2.

Disruption along the Basin Plan Alternative alignment will be short-term. Revegetation and repopulation by wildlife will occur after the construction period. This restoration of habitat, whether it results from implementation of a revegetation program (Section III.3) or from natural processes of repopulation, will result in a reduction in the visibility of the project and will reduce the impacts observed during construction on biological productivity. Restoration of existing land-use patterns and implementation of proposed land-use plans will be essentially unrestricted by the in-place pipeline.

III.4.2 MAINTENANCE OR ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Long-term improvements in the water quality of San Francisco Bay are expected to be the result of implementation of the Basin Plan Alternative, in that a decrease in loading of potentially toxic materials to the South Bay by the discharge of wastewater would occur. These improvements could contribute to an increase in the biological productivity of the South Bay and therefore enhance the beneficial uses of the South Bay (i.e., recreation and wildlife habitat) at the expense of local degradation of existing water quality at the discharge point and in the dead-end sloughs now receiving the discharges. However, a potential decrease in habitat diversity in the wildlife refuge will result from the removal of freshwater flows from Artesian Slough, and a potential increase in salinity of the South Bay will result.

As discussed in Sections II.1.1, II.1.2, and III.1.2, it is not possible to estimate the potential productivity of San Francisco Bay, nor the effect, if any, at reducing toxicity in the South Bay on biotic productivity. Species diversity and population growth may be influenced by other factors which mask the improvement.

The pumping stations and pipeline will preclude future uses of the alignment for industrial or other intensive development; noise, energy consumption, and visible impacts will be evident at each pumping station. These restrictions and impacts are not inconsistent with present or designated uses of the Baylands, but they will persist for the life of the project.

Disposal is not growth-related (Section III.6), and no increases in treatment plant capacity are planned. Therefore, no secondary impacts on air quality are expected.

III.4.3 NEED FOR THE PROJECT

The disposal of treated wastewater historically has been a serious problem confronting both the state water quality regulatory agencies and the wastewater discharge agencies within the San Francisco Bay watershed. The increase in pollutants and the attendant degradation in water quality in the Bay have been especially acute in the waters south of the Dumbarton Bridge because of its relatively low freshwater inflows and poor tidal dispersion. Within the last decade, strict water quality and effluent standards have been promulgated by the San Francisco Bay Regional Water Quality Control Board (RWQCB, 1974), the State Water Resources Control Board (SWRCB, 1974), and the Federal Government (Public Law 92-500), including the 1974 prohibition against discharge into the Bay south of the Dumbarton Bridge (SWRCB and RWQCB, 1975). These standards have resulted in the requirement for the South Bay Dischargers Authority (SBDA) to consider the construction of a new conveyance and disposal system for discharge of treated wastewater in areas of minimal environmental impact. Disposal north of the Dumbarton Bridge, where the tidal action will better disperse the discharge, has been designated in the Basin Plan (SWRCB and RWQCB, 1975) as having the least environmental impact. The goal of the Basin Plan Alternative, therefore, is to protect the beneficial uses established for the Bay in the Basin Plan (Section II.1.2) by meeting water quality objectives set by that board.

Reserving action (the no further action alternative) or implementation of some other alternatives will also protect some beneficial uses (see also Section IV). The maximum increase in water quality for money expended would be from implementation of individual deep-water discharges (Alternative 3); this alternative, however, does not meet dissolved oxygen (DO) criteria in the headwaters of Artesian Slough, does not meet the prohibition against discharge south of Dumbarton Bridge, does not preserve the freshwater environments in the sloughs, and results in greater construction impacts in and near the San Francisco Bay National Wildlife Refuge.

No further action would meet water quality criteria in open water above Calaveras Point with no additional cost or construction impacts. The precise location at which DO criteria are not met is uncertain due to limitations of the water quality model (Exhibit III.1). Wastewater loadings, however, would continue in the sloughs, DO levels of 5 mg/l would not be met for the lengths of Coyote Creek and Artesian or Guadalupe Sloughs, the prohibitions against discharge south of Dumbarton Bridge and to dead-end sloughs will not be complied with, and a minimum 10:1 dilution of wastewater cannot be met with this alternative. In the portions of these sloughs near their entrances to San Francisco Bay, DO levels would be similar to those achieved by other alternatives. However, the precise cause of decreased oxygen levels differs from other alternatives, in that much of the oxygen demand attributed to no further action results from wastewater loading, while the decreased oxygen for the Basin Plan Alternative is due primarily to expression of natural background (benthic and marsh) loadings. Since the Basin Plan Alternative indicates that natural factors cause lower concentrations than the 5.0 mg/l standard, "controllable water quality factors shall not cause further reduction in dissolved oxygen" (SWRCB and RWQCB, 1975). Continued discharge under no further action constitutes a violation of standards, while other alternatives may not violate standard, even though the oxygen levels achieved are similar to those for the Basin Plan Alternative.

III.5

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED

III.5.1 PERMANENT CHANGES IN LAND FEATURES AND LAND USE

Occupation of the Basin Plan Alternative right-of-way will preempt the future use of this area for any other construction.

Existing land-use and topographical features of the land at the San Jose/Santa Clara, Sunnyvale, and Palo Alto pumping stations will be permanently altered by construction. Construction will result in the commitment of approximately 0.3 acre of land currently designated for wastewater treatment at each of the San Jose/Santa Clara and Palo Alto treatment plants, and 0.3 acre of land at Sunnyvale, presently in agricultural use. Such land uses are consistent with current land use at San Jose/Santa Clara and Palo Alto and are in agreement wih industrial development plans of the Moffett Industrial Park in Sunnyvale.

III.5.2 BIOLOGICAL SYSTEMS

The discontinuation of freshwater discharge into Artesian Slough will result in the transition of this area from freshwater to saltwater habitats. This will have a permanent impact on the biotic composition in this slough and reduce the acreage of freshwater habitat in the Baylands area. At this time, it is anticipated that 100-percent of the freshwater habitat in Artesian Slough (approximately four miles) will be lost. This constitutes a reduction in the habitat diversity, a loss of tule and cattail vegetation, and a possible decrease in wading bird nesting and roosting grounds south of Dumbarton Bridge.

Rare or endangered species known to occur in Santa Clara County Baylands habitat include:

- California clapper rail — secondary nesting areas along the dikes and sloughs from the Santa Clara/San Mateo County boundary south through Alviso Slough.
- Salt marsh harvest mouse — marshes along Bayland dikes and sloughs.
- California least tern — seen feeding in the vicinity of Charleston Slough and Salt Pond A-1.
- California brown pelican — utilizes salt ponds near Charleston Slough.
- American peregrine falcon — rare visitor to Baylands.
- Black rail — rare resident of Baylands.

Due to the subgrade location of the Basin Plan Alternative, permanent detrimental impacts on the habitats of these species are not expected to occur along the pipeline route.

III.5.3 ASSIMILATIVE CAPACITY OF THE BAY

The discharge of treated wastewater at a disposal point north of Dumbarton Bridge constitutes an irreversible commitment of the assimilative capacity of the Bay at that point. The potential for buildup of heavy metals and other conservative elements in bottom sediments could alter the future water and sediment quality at this point, even if discharge is discontinued at some future date. Recovery of such an area would be slow, lasting many years, and conservative elements would likely be retained in the sediments.

III.5.4 RESOURCES COMMITTED TO CONSTRUCTION, OPERATION, AND MAINTENANCE OF THE BASIN PLAN ALTERNATIVE

The principal resources committed to the construction, operation, and maintenance of the Basin Plan Alternative are land, materials, energy, and labor:

- 20,800 linear feet of 90-inch I.D. (inside diameter) pipe (steel or concrete pipe, depending on final contracts)

- 38,900 linear feet of 96-inch I.D. pipe
- 25,700 linear feet of 102-inch I.D. pipe
- 450 linear feet of 72-inch I.D. pipe and 256 linear feet of 48-inch I.D. pipe (used for construction of the diffuser)
- 497,000 cubic yards of granular backfill
- 1,166,000 cubic yards of spoil (dumped at a suitable landfill site approved by the Regional Water Quality Control Board); 711,000 cubic yards of dredged spoil (disposed near Alcatraz Island)
- Concrete, instrumentation, and mainline and booster pumps at each of the pumping stations
- 613,000 manhours expended during construction of the project
- $86.123 million committed to construction, plus $321,000 committed to operation and maintenance during the first year of operation

For the first year of operation, the pumping stations will require an average of 1.25 x 10^6 kilowatt-hours/year in power of San Jose/Santa Clara; 2.62 x 10^6 kilowatt-hours/year at Sunnyvale; and 4.01 x 10^6 kilowatt-hours/year at Palo Alto (see Section III.1.3 for estimated annual pumping costs). This power consumption of 7.88 x 106 kilowatt-hours/year is equivalent to approximately 4,900 barrels of crude oil, or to the average annual use of electricity by 1300 Santa Clara County homes (assuming 500 kW/mo per home). To place t is in perspective, the same energy consumption would ur if each of 1,193,400 residents of Santa Clara County burned two 150-watt light bulbs for slightly less than 24 hours each year. Additional resources will be expended for operation and maintenance of the pipeline and pumping facilities in the form of lubricants, replacement parts, and manhours.

III.6

GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE

The Basin Plan Alternative has been proposed to provide an environmentally acceptable means to protect the beneficial uses of South San Francisco Bay. Sizing of the conveyance system and associated pumping station is based on low growth (E-zero) population projections through 1995 for the SBDA service area and will not expand the basic design capacity of the wastewater treatment systems. Accordingly, by design, the construction and operation of the proposed project will have no direct growth-inducing impact on either the population or the economy (gross regional product) of the area.

Indirect economic growth in the form of employment and personal income will occur during construction of the project, but the resultant economic stimulus will last only as long as construction activity occurs. Consequently, no long-term increase to gross regional product will occur from either the construction or operation of the Basin Plan facilities.

BLANK PAGE

BLANK PAGE

Section IV

ALTERNATIVES TO THE BASIN PLAN

IV.1

INTRODUCTION

During the five-year development of the wastewater management plan for the South Bay Dischargers Authority, a number of treatment and disposal alternatives were examined. While approvals of projects for improved treatment were granted SBDA members in 1974 and 1976 by the State of California and the Environmental Protection Agency, no approval has been granted for any new facilities for the disposal of the treated wastewater. In this section, a number of disposal alternatives are evaluated that were considered in the management plan (Consoer-Bechtel, 1972; Bechtel, 1973; Bechtel, 1974) and in other studies (Consoer-Bechtel, 1973; Environmental Science Associates, 1974; Culp/Wesner/Culp, undated; USDI, 1975). These evaluations, presented in a summarized form in Section I.2, are presented and analyzed in detail in the following sections. The alternatives discussed are:

Alternative Number	Description
1	Joint outfall pipeline connecting the three treatment plants discharge to a point about one mile north of Dumbarton Bridge — the Basin Plan Alternative.
2	Continue discharging locally. Complete advanced waste treatment facilities now planned or under construction at each of the existing treatment plants. Defer the pipeline project or further treatment upgrading until the actual effect of these advanced treatment facilities on the South Bay can be observed.
3	Conveyance of treated wastewater to deep water south of Dumbarton Bridge via individual pipelines.
4	Highly advanced treatment at each plant and continued discharge locally.

5 Conveyance of all or a portion of the treated wastewater to a reclamation/treatment plant. After further treatment, the reclaimed wastewater is transported to the reuse market.

6 Consolidation with other dischargers and conveyance of wastewater to a discharge point north of San Mateo Bridge.

7 Pipeline and tunnel through the Santa Cruz Mountains, discharging in deep water in the Pacific Ocean.

8 Pipeline, storage, and dispersal facilities for the spreading of wastewater on land. This disposal precludes the requirement for upgraded treatment; the soil acts as an advanced treatment system.

9 Using phased development of treatment and disposal systems, in conjunction with source control, land-use planning, and environmental regulations, to regulate the quantity and quality of the wastewater.

Preexisting constraints and assumptions are discussed briefly in Section I.2, and various regulatory requirements are presented in Appendix L.

IV.2

ALTERNATIVES

IV.2.1 ALTERNATIVE 1 — A SINGLE OUTFALL TO THE BAY NORTH OF DUMBARTON BRIDGE (*VARIATIONS*)

Alternative 1 considers a pipeline in several different alignments, resulting in consolidation of three subregional facilities, to convey the treated wastewater to a point in the deep channel north of Dumbarton Bridge for discharge through a diffuser (Figure IV-1). This alternative has been analyzed in detail in previous reports prepared for the SBDA by Consoer-Bechtel (1972) and Bechtel (1974) as a means for effective disposal of treated wastewater. Criteria considered in these past studies included a comparison of disposal points and water quality criteria for receiving waters with the costs necessary to achieve the criteria. These studies are summarized in the following paragraphs.

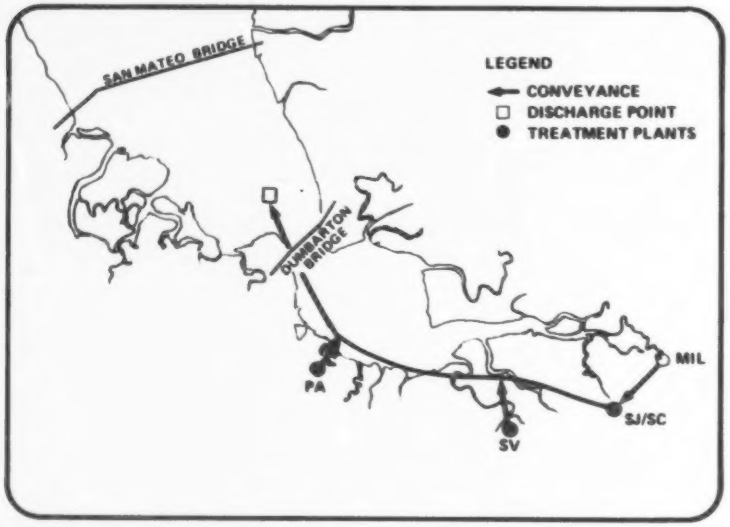


Figure IV-1 SCHEMATIC – ALTERNATIVE 1

Consoer-Bechtel (1972) based its analysis of wastewater management for the South Bay on a number of criteria: beneficial uses of the receiving waters, water quality objectives, existing water quality problems, population and waste flow projections, and financial and governmental considerations. The conveyance alternative, which included Menlo Park and the Union-Newark area as well as present SBDA members, was the selected alternative of five systems studied. The reasons for its selection were that it has the lowest costs for meeting existing and assumed water quality objectives and high flexibility for meeting future conditions. Specifically, this alternative pipeline/treatment system would:

(1) Meet water quality standards for dissolved oxygen, coliform bacteria, and flotables in open waters of San Francisco Bay, as well as comply with the minimum oil dilution and the prohibition of discharge south of Dumbarton Bridge or to dead-end sloughs.

(2) Reduce toxicant and biostimulant levels in the Bay south of Dumbarton Bridge

(3) Be flexible, allowing future conversion, as desired, for conveyance north of San Mateo Bridge, ocean disposal, or conveyance south for reclamation or land disposal

(4) Be regional, resulting in consolidation of three wastewater treatment plants

Disadvantages of the system according to Consoer-Bechtel (1972) were:

(1) Reduced freshwater inflow to the Bay south of Dumbarton Bridge

(2) Would still not meet toxicity objectives of the RWQCB in that some toxicity attributable to wastewater loadings would be expressed at the discharge point.

(3) Higher cost than local conveyance systems because of the interceptor connecting the three plants

In a follow-up study, Bechtel (1974) analyzed nine treatment/disposal alternatives open to the members of SBDA, using as criteria preliminary estimates of capital and operating costs, environmental analysis (of six alternatives), water quality objectives and water quality problems, flexibility, compatibility with regional reclamation and reuse, and institutional constraints. The "conveyance of wastewater to a point north of Dumbarton Bridge" was the selected alternative. Menlo Park and the Union Sanitary Districts were not included in this study, having elected to participate in other studies. Benefits of the conveyance include:

(1) Compliance with existing and assumed water quality standards in open waters of the Bay

(2) Moderate cost (only two alternatives -- local deepwater discharge and no project -- were less expensive per capita per year)

(3) Flexibility for meeting more stringent water quality objectives, for "best practicable" treatment, or for implementation of reclamation

(4) Design flexibility, which allows reversal of flows and accommodation of effluent flows from San Francisco and San Mateo Counties. This flexibility permits future implementation of large-scale (Bay Area) reclamation projects

Disadvantages attributable to the system were:

(1) Potential for short-term environmental impacts -- water quality, aesthetics, and wetlands -- during construction. Other alternatives presented similar potential impacts, varying with the length and location of the disposal system

(2) Removal of freshwater from extremities of the South Bay and resultant loss of flushing in the sloughs

(3) Potential for impact on resources of San Mateo County (location of discharge) during bypass or other emergency or upset conditions

(4) Estimated capital cost of $86.1 million plus operation and maintenance costs for the first year of operation of $321,000.

Participation by Other Entities

Alternative 1 is flexible enough to allow the addition of other, smaller discharges to the pipeline for disposal through the diffuser. In 1976, at the request of the SWRCB and RWQCB (2), the effect of such an addition by Leslie Salt Company was analysed. This subalternative is discussed in Section VI of this EIR/EIS.

Alternative Alignments

During the formulation of the wastewater management plan (Bechtel, 1974), alternative alignments for a disposal system to the north of Dumbarton Bridge were studied. The alignments (Figure IV-2) were an "on-land" route and an "estuarine" route. Preliminary cost estimates, available soils and foundation data, and expressed concerns of local and county agencies, regulatory authorities, property owners, and other concerned groups or individuals were considered in this study.

The on-land route is 80 percent on dry land with two options for connecting the deepwater outfall to the Palo Alto plant. Option 1 would follow the boundary of East Palo Alto, adjacent to the proposed Embarcadero Road approach to the new Dumbarton Bridge, as far as the Hetch Hetchy aqueduct. This option would minimize impact on the area, should the highway be built, and would avoid the Faber Tract and other diked Bayland preserves. In addition, the routing along the aqueduct would avoid the National Wildlife Refuge area at Ravenswood Point and the deep layers of soft Bay Mud in this area (Harlan and Associates, 1973) (Figure IV-2).

The disadvantages of Option 1 include potential impacts on the University Village archaeological site (see Appendix H) and on a proposed linear park along a portion of the alignment (Figure II-18).

Option 2 would pass through Palo Alto Airport property, cross the levee at the existing discharge point of the Palo Alto treatment plant, and follow the outfall channel to Mayfield Slough channel and out to the disposal area (Figure IV-2). This option passes through the Palo Alto salt marsh north of the airport, and, although construction activities would be centered on the existing discharge canal, some disruption of wildlife would result from the presence of construction crews. In addition, construction in the airport property could disrupt use of this area for a period of time.

The on-land route is approximately 17 miles long with Option 1 and 16 miles long with Option 2. On-land construction could be accomplished using four or more crews, simultaneously, with a minimal increase in construction costs. This construction approach would shorten the construction time necessary for completion of the project.

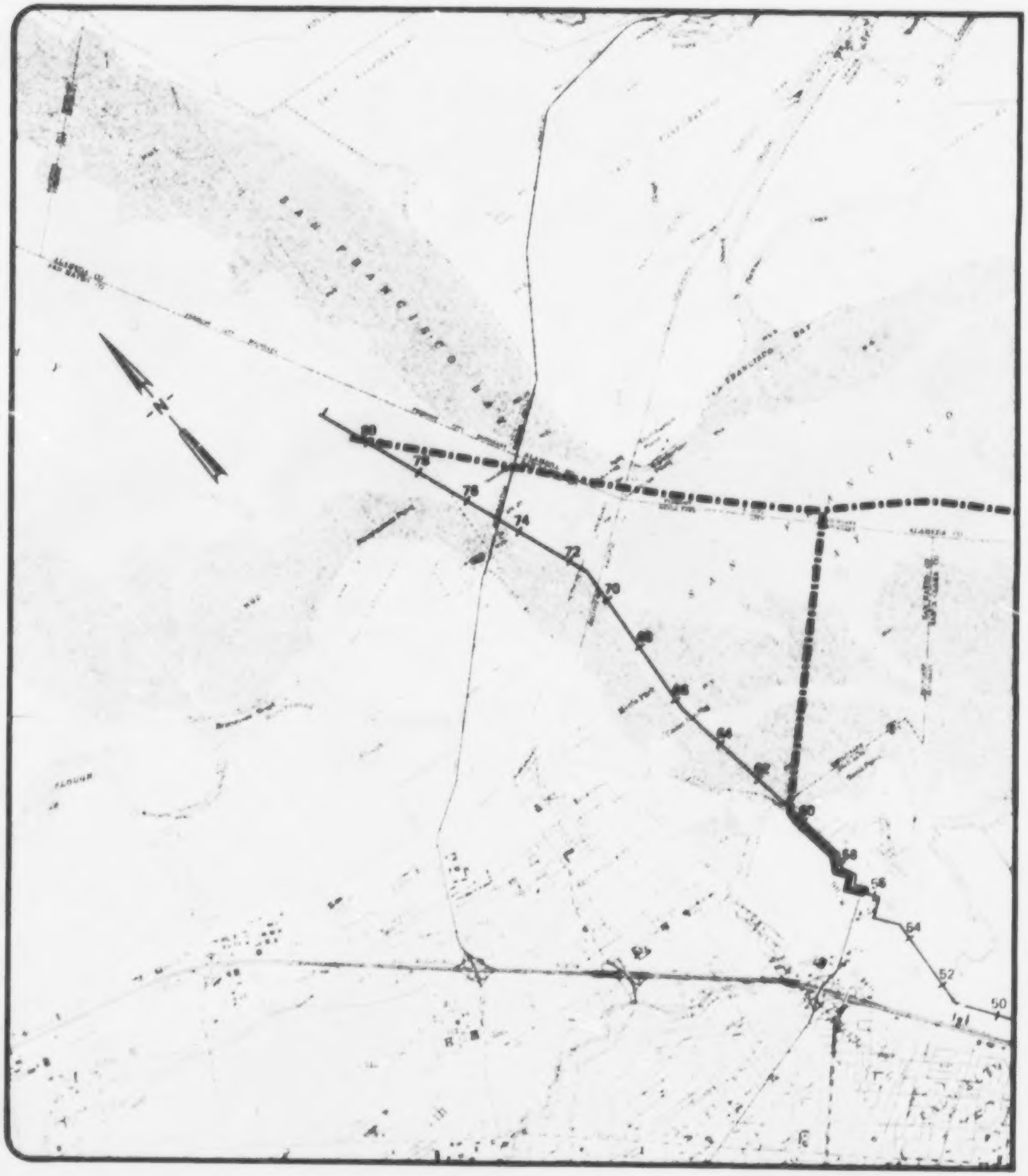
The "estuarine" route is approximately 14 miles long, with a 3-mile-long connector from Palo Alto. Construction along much of the route would require the use of deep-draft pipeline barges as well as land crews. The limited availability and the cost of the necessary barge equipment could make the use of more than one barge uneconomical. The construction time for completion of this project, therefore, could be longer than for the on-land route.

Cost comparisons prepared in November 1973 included construction costs based on direct labor costs, equipment, and job and permanent materials, as well as estimates of contractor indirect costs. Other costs estimated were land and right-of-way costs based on sales data for comparable lands, county tax records, and information from utilities and other companies. These comparative estimates showed that the cost for construction on land was somewhat less than the estuarine alternative, but that land and right-of-way acquisition costs were higher, with the result that total costs of the two alternatives wére generally comparable. However, Bechtel noted that there is a far greater degree of uncertainty associated with the cost of construction along the estuarine route, including availability of equipment, costs for construction in salt ponds (which requires maintenance of levee integrity and restoration of bottom surfaces in the ponds), disposal of large quantities of dredge spoils, and the timing necessary for construction.

Environmental impacts associated with the on-land route, as described in Section III, include the potential disturbance of the Palo Alto salt marsh and disruption of mud flat and open water biological communities in the underwater portion of the alignment. The estuarine alignment would affect the salt marsh habitat at the salt pond levees near Devil's Slough, as well as the salt ponds and levees. Other impacts would include disruption of the mud flat community in the southern portion of the Bay and impacts on open water communities. The construction impacts for either alternative would be short-term, lasting only as long as construction activity and would be partially mitigated through marsh revegetation, restoration of salt evaporator surfaces, and the use of clean backfill in the excavated trench.

Result of Screening

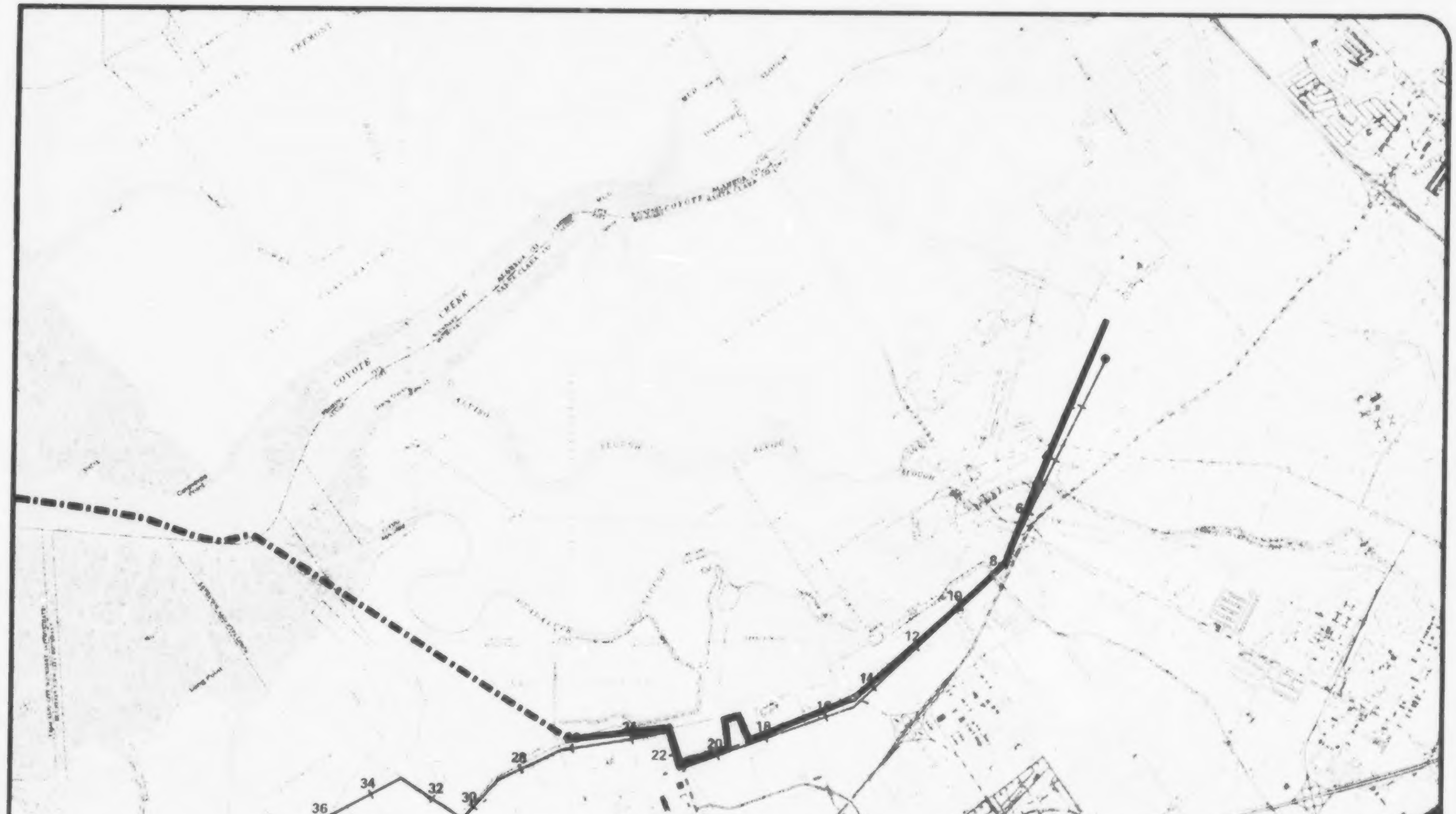
Alternative 1 was determined to be a viable alternative to meet water quality requirements and the prohibition of discharge south of Dumbarton Bridge. The on-land alignment using Option 2 to connect the Palo Alto treatment plant with the diffuser was selected as the Basin Plan Alternative. This alignment presented fewer costly and time consuming construction problems. While Option 2 has potential for impact on the environment,


SAN FRANCISCO BAY
N
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
50

LEGEND:

▬	ON-LAND PORTION OF ESTUARINE ALIGNMENT
·–·–	ON-WATER PORTION OF ESTUARINE ALIGNMENT
–+–	ON-LAND ALIGNMENT

Figure IV-2
ALTERNATIVE ALIGNMENTS


FREMONT
COYOTE
CREEK
COYOTE
SLOUGH
SCALE IN MILES
6
8
10
12
14
16
18
20
22
24
28
30
32
34
36
38
40
42
44
46
48

mitigation of these impacts presents fewer difficulties in timing and cost than for Option 1. Option 2 does not have the potential for archeological impact that Option 1 has.

IV.2.2 ALTERNATIVE 2 – NO ACTION BEYOND CURRENTLY APPROVED IMPROVEMENTS AT THE TREATMENT PLANTS

In a "no further action" alternative, it is assumed that all facilities currently in operation, under construction, or in final design would be included, but no conveyance facility would be built at this time. As in Alternative 4, upgraded treatment with disposal at site, discharges would continue at the present locations (Figure IV-3), continuing freshwater flows to Artesian and Guadalupe Sloughs. Once the advanced treatment facilities are operational at the San Jose/Santa Clara facility, Artesian Slough would not revert to a saline slough for its entire length under this alternative.

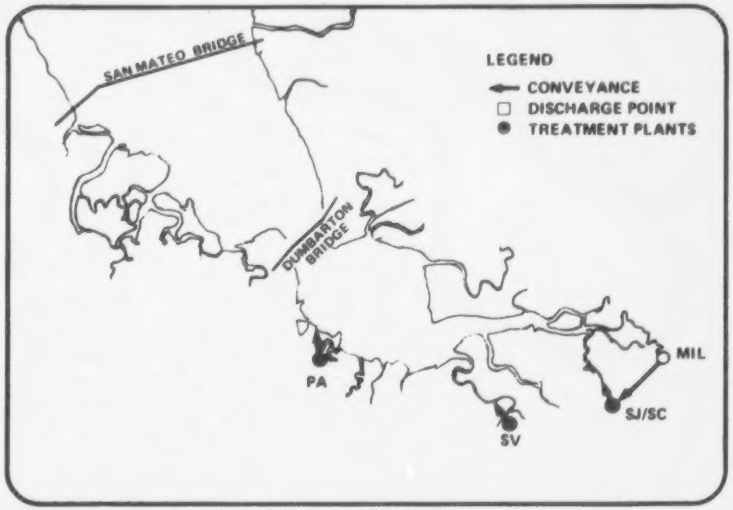


Figure IV-3 SCHEMATIC – ALTERNATIVE 2

In this alternative, dissolved oxygen levels in the open waters of the South Bay would increase, although Artesian and Guadalupe Sloughs would experience depletion of dissolved oxygen during the dry (summer) and canning seasons (Figure IV-4). These depletions would affect a greater portion of the sloughs than predicted for Alternative 4 or the Basin Plan Alternative. However, predicted oxygen concentrations would be more or less equal along the length of Artesian Slough, while the Basin Plan Alternative could result in more severe depletion in the headwaters at Artesian Slough (see also Section III, Figure III-1).

No significant change in salinity would result in the South Bay if this alternative were implemented (Figure III-2 and Appendix C), but relative toxicity levels would be as much as an order of magnitude higher than expected for the Basin Plan Alternative (approximately 400 m/l rather than 50 m/l). This continued discharge of toxicity may continue to contribute to a decreased biological potential in the South Bay, by depressing biological diversity and restricting the spread of more sensitive species into the area. This alternative does not comply with the prohibition to discharge south of Dumbarton Bridge or to dead-end sloughs. It does not comply with the minimum 10:1 effluent dilution.

Continued flows to Artesian Slough would result in maintenance of the freshwater bird habitat in the slough. This benefit to the Wildlife Refuge could constitute an environmental benefit and thus result in an exception to the above-stated prohibitions and requirements for San Jose/Santa Clara. No similar benefit has been demonstrated for Palo Alto or Sunnyvale.

This alternative can be viewed as a phase of a "deferred action" alternative that would allow an interim monitoring program and analysis of the effect of the approved upgraded treatment on the Bay environment.

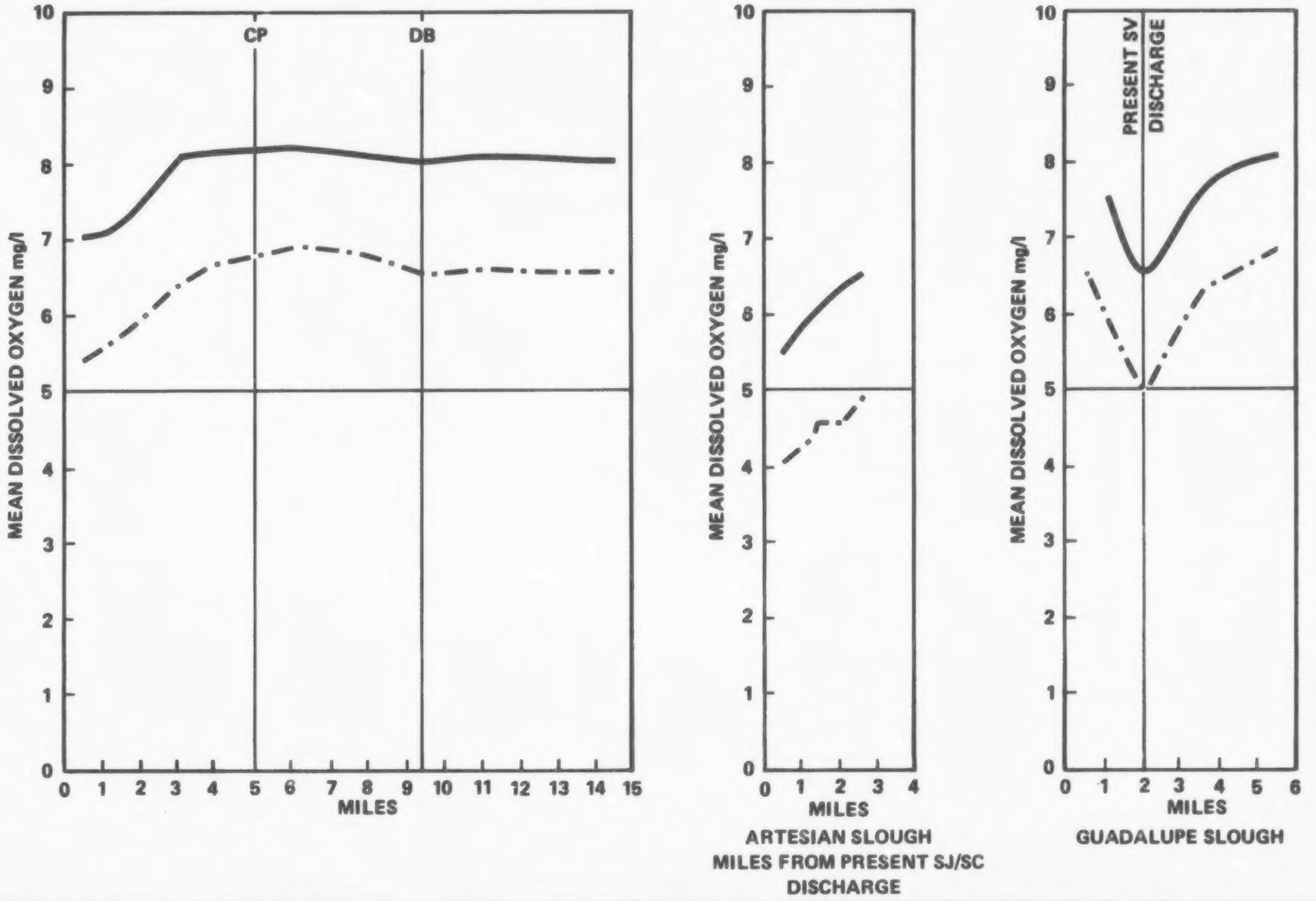


Figure IV-4
WATER QUALITY PARAMETERS ASSOCIATED WITH ALTERNATIVE 2 (HYDROSCIENCE, INC., APPENDIX C).

Should water quality be shown to improve markedly under this alternative, a case could then be made for no additional action. If, however, the rate of improvement were not satisfactory to regulatory agencies, additional treatment, reclamation, or disposal methods could be implemented as needed, and evaluation could be made for each treatment plant separately or for SBDA as a joint discharger. During the phasing of treatment and disposal, alternatives not now considered viable may be developed to a level of reliability, cost-effectiveness, and public acceptance that would allow their implementation.

The no further action alternative has no technical constraints and would require no additional expenditures. This alternative would cost no more than currently approved expenditures. However, delays in construction of an alternative disposal system, if required in later years, would result in an escalation of the cost of that system due to inflation in the cost of labor and materials and energy. In addition, state and federal governments may at some future date reduce or eliminate grant programs, resulting in the requirement for local financing of the entire project. Should a monitoring program show that water quality improvements were not sufficient, implementation of a disposal plan would, as a result of inflation, cost more than currently anticipated for the proposed project.

Result of Screening

This alternative was determined to be viable, since dissolved oxygen levels in open waters would likely improve with no additional expenditures and without construction impacts associated with the outfalls on land or in the Bay. However, this alternative does not comply with prohibitions to discharge south of Dumbarton Bridge or to dead-end sloughs, does not meet 10:1 minimum dilution requirements, and continues to discharge potentially toxic materials to the South Bay. In order to implement a no further action alternative, exceptions to the Basin Plan would be required, or the Basin Plan would have to be amended. Should phasing at the treatment and disposal systems (Alternative 9) be implemented, Alternative 2 with monitoring would be the logical first step in the staging.

IV.2.3 ALTERNATIVE 3 — INDIVIDUAL OUTFALLS TO NEAREST DEEP WATER

Using separate outfalls, each member discharger could, under Alternative 3, convey effluent to the nearest deep water south of the bridge (Figure IV-5). Palo Alto would discharge at a point offshore of the Palo Alto Yacht Harbor, while Sunnyvale and San Jose/Santa Clara would convey their effluents to a discharge near Calaveras Point. This system is technically feasible in that it would meet dissolved oxygen requirements in open waters of the Bay and would discontinue discharge of toxic materials in the sloughs (Appendix C).

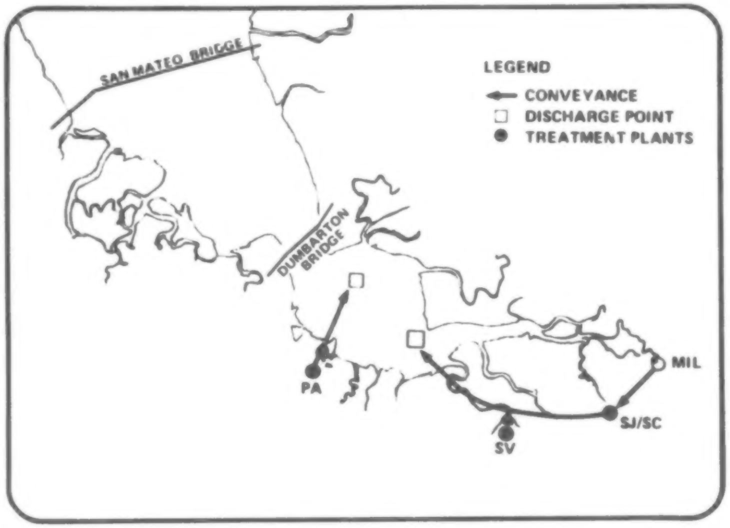


Figure IV-5 SCHEMATIC – ALTERNATIVE 3

However, improvement in water quality in the South Bay would not be as great as with complete removal of the wastewaters from south of the bridge, and flushing would not be continued in the sloughs (Figure IV-6). This system does not comply with the prohibition against discharge south of Dumbarton Bridge, and toxicity south of Dumbarton Bridge would remain high (125 ml/l). This continued discharge of toxic materials may continue to repress the biological potential of the South Bay, although at a lower level than that anticipated from the no further action alternative with 400 ml/l toxicity. This system is not a regional system and would have to be abandoned should large-scale reclamation be implemented or should monitoring of water quality indicate that disposal north of Dumbarton Straits was necessary. However, these outfalls would be usable as winter outfalls and as partial summer outfalls in the event of local or seasonal reclamation programs.

This program would not require the construction of the Basin Plan Alternative, eliminating the relatively low impact dry land construction. However, construction of individual conveyances would result in aquatic impacts similar in type and greater in areal extent to those expected from Alternative 1. These impacts would be localized, short-term, and reversible. They would consist primarily of increased turbidity and suspension of contaminated sediments at dredge sites and at the spoils disposal site, disruption of estuarine mud flat communities along the Sunnyvale-San Jose/Santa Clara conveyance and tidal flat communities along the Palo Alto conveyance, and noise, dust, and limited access along the terrestrial portions of the routes. Depending on the exact alignments, portions of marshlands, dikes, and salt evaporators in the area of the San Francisco Bay National Wildlife Refuge would also be disturbed.

These impacts on water quality and habitat quality would be greater for this alternative than for any other in-Bay alternative for the following reasons:

- Greater length of in-Bay construction, affecting more Bay habitat than with a single outfall
- Construction in salt ponds near the wildlife refuge, including potential for affecting salt pond A-9 and other valuable wildlife habitat (Section II.1.2)
- Crossing of at least three tidal marshes (one marsh for each pipeline crossing at outboard levees), all potential secondary nesting grounds for the endangered California clapper rail
- Increased potential for breaching of dikes in salt ponds
- Increased potential for extensive disturbance of Artesian and Guadalupe Slough beds and additional disturbances to Coyote Creek bed, resulting in locally increased turbidity, interruption of flow, and loss of benthos.

The cost of construction and operation of these deepwater outfalls would be 80 percent of that for the Basin Plan Alternative (about 69 million dollars). Costs of construction in salt ponds and special techniques for this construction were not included in this estimate, however; these activities are expected to increase construction expenditures above 80 percent of the Basin Plan Alternative.

Result of Screening

Because this alternative does comply as well as the Basin Plan Alternative with SWRCB (1974) water quality standards for dissolved oxygen, and because the cost of such an alternative is less, this alternative was considered viable. Disadvantages of this alternative include potential for toxicity buildup in the South Bay, loss of freshwater flushing in the sloughs, and resultant loss of freshwater habitat and degradation of slough water quality. In addition, an increased potential for construction impacts results from this alternative.

CONTENTS

Section Page

I DESCRIPTION OF BASIN PLAN AND ALTERNATIVES

I.1 DESCRIPTION OF ALTERNATIVES 1 1/D13
I.1.1 Introduction 1 1/D13
I.1.2 Background and Objectives 4 1/E5
I.1.3 Criteria for Evaluation of Alternatives 6 1/E9
I.1.4 Evaluation of Alternatives 6 1/E9
Alternative 2 — No Further Action 9 1/F1
Alternative 3 — Individual Outfalls to Nearest Deepwater 10 1/F3
Alternative 4 — Local Discharge with Upgraded Treatment 11 1/F5
Alternative 5 — Reclamation and Reuse of Treated Wastewater 13 1/F9
I.1.5 Alternative Alignments to Basin Plan Alternative 15 1/F13
I.2 THE BASIN PLAN ALTERNATIVE 19 1/G7
I.2.1 Location 19 1/G7
I.2.2 Facilities for the Basin Plan Alternative 21 1/G11
San Jose/Santa Clara Pumping Station 22 1/G13
Pipeline Segment — San Jose Santa Clara to Sunnyvale 22 1/G13
Sunnyvale Pumping Station 22 1/G13
Pipeline Segment – Sunnyvale to Palo Alto 24 2/B1
Palo Alto Pumping Station 24 2/B1
Pipeline Segment — Palo Alto to Discharge Point 24 2/B1
Diffuser 24 2/B1
I.2.3 Construction of the Basin Plan Alternative 25 2/B3
Construction Procedures on Land 25 2/B3
Construction Procedures in Water 26 2/B5
I.2.4 Operation of the Basin Plan Alternative 28 2/B9
I.3 APPROVALS REQUIRED 29 2/B11

II ENVIRONMENTAL DESCRIPTION

II.1 PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT) 31 2/C3
II.1.1 Physical Environment 31 2/C3
Topography 31 2/C3
Geology and Seismology 33 2/C7
Groundwater 33 2/C7
Soils 36 2/C13
Sediments 37 2/D1
Meteorology 39 2/D5
Air Quality 40 2/D7
– The Air Pollution Problem in the Bay Area 40 2/D7
– Emissions and Air Quality 40 2/D7
– Air Quality in the Bay Area 45 2/E3
– Air Impacts of Wastewater Disposal 45 2/E3
Hydrology 45 2/E3
– Tides and Currents 46 2/E5
– Circulation and Dispersion 47 2/E7
Water Quality 49 2/E11
– Temperature 51 2/F1
– Transparency 51 2/F1
– pH 51 2/F1
– Suspended Solids 51 2/F1
– Salinity 52 2/F3
– Dissolved Oxygen and Oxygen Demand 53 2/F5
– Nutrients 53 2/F5
– Chlorophyll 54 2/F7
– Coliform Bacteria 54 2/F7
– Oil and Grease 55 2/F9
– Toxicity 55 2/F9
– Heavy Metals 57 2/F13
Noise 57 2/F13
II.1.2 Biological Environment 58 2/G1
South Bay Habitats 58 2/G1
– Open Water 61 2/G7
– Tidal Mud Flats 64 2/G13
– Salt Marsh 68 3/B5
– Salt Ponds 71 3/B11
Dikes and Levees 74 3/C3
– Grasslands 75 3/C5
– Streams and Sloughs 75 3/C5
– Freshwater Marshes and Ponds 77 3/C9
Species of Special Concern 78 3/C11

II.1.3 Social, Economic, and Cultural Environment 83 3/D7
Population and Demography 83 3/D7
Recreational and Scientific Uses of the Area 87 3/E1
Archaeological, Paleontological, Historical and Cultural Resources 88 3/E3
— Archaeological Resources 88 3/E3
— Paleontological Resources 89 3/E5
— Historical and Cultural Resources 89 3/E5
Visual and Aesthetic Setting 93 3/E13
Economic Setting 98 3/F9

II.2 LAND USE

II.2.1 Present Land-Use Patterns 101 3/G1
Existing Land Use 101 3/G1
— Santa Clara County 101 3/G1
— San Mateo County 104 3/G7
Existing Public and Private Developments 104 3/G7
Mineral Resources of the Baylands 112 4/B7
II.2.2 Projected Land-Use Patterns 112 4/B7
Planned Public and Private Developments 112 4/B7
Land-Use Plans and Planning Agencies 114 4/B11
Interested Agencies 118 4/C5
— Local 118 4/C5
— Regional 118 4/C5
— State 118 4/C5
— Federal 119 4/C7

II.3 WATER USE

II.3.1 Existing and Proposed Wastewater Treatment Facilities 120 4/C9
San Jose/Santa Clara Regional Water Pollution Control Plant 120 4/C9
Sunnyvale Water Pollution Control Plant 120 4/C9
Palo Alto Treatment Plant 121 4/C11
Menlo Park Sanitary District Wastewater Treatment Plant 121 4/C11
Redwood City Sanitary District — Redwood City Sewage Treatment Facility 121 4/C11
Redwood City Sanitary District — Redwood Shores Plant 122 4/C13
Belmont/San Carlos Joint Sewage Treatment Facility 122 4/C13
Proposed Redwood Shores Subregional Plant 122 4/C13
Union Sanitary District — Alvarado, Plant No. 3 122 4/C13
Union Sanitary District — Newark, Plant No. 1 122 4/C13
Union Sanitary District — Irvington, Plant No. 2 122 4/C13
II.3.2 Current and Projected Sources of Water 122 4/C13
II.3.3 Current Water Use and Projected Demand 123 4/D1
II.3.4 Current and Projected Water Quality 123 4/D1

III ENVIRONMENTAL IMPACTS

III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129 4/E1
III.1.1 Construction Impacts 129 4/E1
Physical Environment 129 4/E1
— Topography 129 4/E1
— Air Quality 130 4/E3
— Water Quality 131 4/E5
— Sediment Quality 132 4/E7
— Noise 132 4/E7
Biological Environment 133 4/E9
— Segment I — San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134 4/E11
— Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant 136 4/F1
— Segment III — Palo Alto Treatment Plant to Discharge Point 138 4/F5
Social, Economic, and Cultural Environment 140 4/F9
— Recreational Uses of the Area 140 4/F9

– Archaeological, Paleontological, and Historical Resources 141 4/F11
– Visual and Aesthetic Setting 141 4/F11
– Economic Setting 141 4/F11
– Present Land-Use Patterns 143 4/G1
– Projected Land-Use Patterns 144 4/G3
III.1.2 Operation Impacts 144 4/G3
Physical Environment 144 4/G3
– Hydrology 144 4/G3
– Water Quality 144 4/G3
– Sediment Quality 148 4/G11
– Noise 150 5/A13
Biological Environment 152 5/B3
Social, Economic, and Cultural Environment 154 5/B7
– Recreational Uses of the Area 154 5/B7
– Visual and Aesthetic Setting 155 5/B9
– Present and Future Land-Use 155 5/B9
– Energy Consumption 155 5/B9
III.1.3 Economic Impact of the Basin Plan Alternative 155 5/B9
Introduction 155 5/B9
Study Assumptions and Methodology 155 5/B9
– Capital Costs 156 5/B11
– Operation and Maintenance Costs 158 5/C1
Computation of Allocation Factors 158 5/C1
User Charges to Discharger Groups 159 5/C3
– Residential Dischargers 159 5/C3
– Commercial Dischargers 159 5/C3
– Industrial Dischargers 159 5/C3
– Direct Impact on Industrial Dischargers 162 5/C9
Analysis of the Canned Fruit and Vegetable Industry 163 5/C11
– Industry Characteristics 163 5/C11
– Methodology 164 5/C13
– Conclusions of Analysis 165 5/D1
Conclusions 165 5/D1
III.1.4 Accident or Natural Catastrophe 166 5/D3
Flooding 166 5/D3
Earthquake 166 5/D3
Plant Upset 166 5/D3
Pumping Station Malfunction 166 5/D3
III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168 5/D7
III.2.1 Adverse Construction Effects 168 5/D7
Physical Environment 168 5/D7
Biological Environment 168 5/D7
Social, Economic, and Cultural Environment 168 5/D7
III.2.2 Adverse Operational Effects 169 5/D9
Physical Environment 169 5/D9
Biological Environment 169 5/D9
Social, Economic, and Cultural Environment 169 5/D9
III.3 MITIGATION MEASURES 170 5/D11
III.3.1 Mitigation of Construction Impacts 170 5/D11
Proposed Measures 170 5/D11
Potential Measures 172 5/E2
III.3.2 Mitigation of Operation Impacts 173 5/E3
Proposed Measures 173 5/E3
Potential Measures 173 5/E3
III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174 5/E5
III.4.1 Short-Term Uses of Man's Environment 174 5/E5
III.4.2 Maintenance and Enhancement of Long-Term Productivity 174 5/E5
III.4.3 Need for the Project 175 5/E7
III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176 5/E9
III.5.1 Permanent Changes in Land Features and Land Use 177 5/E11
III.5.2 Biological Systems 177 5/E11
III.5.3 Assimilative Capacity of the Bay 177 5/E11
III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177 5/E11
III.6 GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178 5/E13

IV ALTERNATIVES TO THE BASIN PLAN

IV.1 INTRODUCTION 181 5/F7
IV.2 ALTERNATIVES 182 5/F9

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183 5/F11
Participation by Other Entities 184 5/F13
Alternative Alignments 184 5/F13
Result of Screening 185 5/G1
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188 5/G7
Result of Screening 190 5/G11
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190 5/G11
Result of Screening 191 5/G13
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193 6/B1
Result of Screening 195 6/B5
IV.2.5 Alternative 5 — Reclamation and Reuse 195 6/B5
Reclamation in Santa Clara County 197 6/B9
Smaller Reuse Markets in the Service Area 199 6/B13
Markets Outside the Service Area 201 6/C3
Result of Screening 202 6/C5
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202 6/C5
Result of Screening 203 6/C7
IV.2.7 Alternative 7 - Discharge to the Ocean 203 6/C7
Result of Screening 204 6/C9
IV.2.8 Alternative 8 — Land Disposal 204 6/C9
Result of Screening 205 6/C11
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206 6/C13
Result of Screening 206 6/C13

V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION

V.1 INTRODUCTION 207 6/D3
V.2 STUDY AREA 209 6/D7
V.2.1 Location of Study Area 210 6/D9
V.2.2 Water Demand and Supply 210 6/D9
V.2.3 Quality of Groundwater Supplies 213 6/E1
V.2.4 Quality of Soils 213 6/E1
V.2.5 Agricultural Land Use 215 6/E5
V.3 CONCEPTUAL DESIGN 217 6/E9
V.3.1 Potential Markets 218 6/E11
V.3.2 Reclaimed Water Quality 219 6/E13
Source Control 221 6/F3
Level of Reclaimed Water Treatment 222 6/F5
V.3.3 Treatment Conceptual Designs 224 6/F9
Reclaimed Water Flow Diversion 226 6/F13
Coagulation and Sedimentation with Alkalinity Control 226 6/F13
Alkalinity Control 230 6/G7
Partial Desalination Treatment 232 6/G11
V.3.4 Conveyance and Distribution Conceptual Designs 233 6/G13
Pumping 234 7/A13
Conveyance Pipeline 235 7/B1
Santa Clara Valley Distribution System 236 7/B3
Bolsa Distribution System 236 7/B3
User Connections 236 7/B3
V.3.5 Cost Estimates 242 7/C1
Basis of Estimate 242 7/C1
Engineering Construction Management Contingency 244 7/C5
Escalation 244 7/C5
Schedule 244 7/C5
Operation and Maintenance 244 7/C5
Major Exclusions 244 7/C5
Assumptions 244 7/C5
V.3.6 Blending Alternatives 244 7/C5
Blended Water Quality 245 7/C7
Blended Water Markets 245 7/C7
Blended Water Distribution 246 7/C9
Blending System Alternatives 247 7/C11
V.3.7 Alternating Supply Alternatives 247 7/C11
V.3.8 Summary 248 7/C13
V.4 AGRICULTURAL IMPACTS 249 7/D1
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250 7/D3
Salinity Effects 251 7/D5
Effects of High Sodium Concentrations 253 7/D9

Specific Ion Toxicity 255 7/D13
Summary of Effects on Agriculture of Cases A and B 255 7/D13
V.4.2 Impact of Cases C, D, B_1, B_2, and B_3 in the Santa Clara County Portion of the Study Area 256 7/E1
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257 7/E3
V.5 ECONOMIC IMPACT ANALYSIS 259 7/E7
V.5.1 Conceptual Level Costs 259 7/E7
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260 7/E9
V.5.3 Economic Impact on Agriculture 260 7/E9
V.6 OTHER IMPACTS 263 7/F1
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264 7/F3
V.6.2 Long-Term Buildup of Salts in Soil 265 7/F5
V.6.3 Public Health Concerns 265 7/F5
V.6.4 Effects on Land Use and Water Use 266 7/F7
V.6.5 Energy Consumption 266 7/F7
V.6.6 Other Effects 267 7/F9

VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270 7/G3
VI.1.1 Disposal of Bittern 271 7/G5
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272 7/G7
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273 7/G9
VI.1.4 Other Disposal Alternatives 276 8/A13
Continued Storage 276 8/A13
On-Land Dilution 276 8/A13
VI.2 PRESENT ENVIRONMENT 277 8/B1
VI.2.1 Physical Environment 277 8/B1
Topography 277 8/B1
Soils 278 8/B3
Sediments 278 8/B3
Hydrology 278 8/B3
Water Quality 278 8/B3
— Temperature and Salinity 278 8/B3
— Chemical Characteristics 280 8/B7
VI.2.2 Biological Environment 280 8/B7
Open Water and Tidal Mud Flats 280 8/B7
Salt Marsh 280 8/B7
Salt Ponds 280 8/B7
Dikes and Levees 282 8/B11
Streams and Sloughs 282 8/B11
Species of Special Concern 283 8/B13
VI.2.3 Social and Cultural Environment 283 8/B13
Recreational Uses of the Area 283 8/B13
Archaeological, Paleontological, Historical, and Cultural Resources 284 8/C1
Visual and Aesthetic Setting 284 8/C1
Existing and Proposed Land Use 284 8/C1
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285 8/C3
VI.3.1 Discharging to Basin Plan Alternative 285 8/C3
Construction Impacts — Physical Environment 285 8/C3
— Topography 285 8/C3
— Air Quality 285 8/C3
— Water Quality 286 8/C5
— Sediment Quality 286 8/C5
— Noise 286 8/C5
Construction Impacts — Biological Environment 286 8/C5
— Salt Pond Dikes 286 8/C5
— Open Water 286 8/C5
Construction Impacts — Social, Economic, and Cultural Environment 287 8/C7
— Recreational Uses of the Area 287 8/C7
— Archaeological, Paleontological, and Historical Resources 287 8/C7
— Economic Setting 237 8/C7
— Present and Projected Land-Use Patterns 287 8/C7
Operational Impacts — Physical Environment 287 8/C7
— Water Quality 287 8/C7
— Sediment Quality 290 8/C13
— Noise 290 8/C13
Operational Impacts — Biological Environment 291 8/D1

Operational Impacts — Social, Economic, and Cultural Environment 292 8/D3
— Economic Setting 292 8/D3
VI.3.2 Discharging Through Separate Diffusers 292 8/D3
Construction Impacts — Physical Environment 292 8/D3
— Topography 292 8/D3
— Air Quality 292 8/D3
— Water Quality 292 8/D3
— Sediment Quality 292 8/D3
— Noise 292 8/D3
Construction Impacts — Biological Environment 293 8/D5
— Salt Pond Dikes 293 8/D5
— Open Water 293 8/D5
Construction Impacts — Social, Economic, and Cultural Environment 293 8/D5
— Recreational Uses of the Area 293 8/D5
— Visual and Aesthetic Setting 293 8/D5
— Economic Setting 293 8/D5
— Present and Projected Land-Use Pattern 294 8/D7
Operational Impacts — Physical Environment 294 8/D7
— Water Quality 294 8/D7
— Sediment Quality 295 8/D9
— Noise 295 8/D9
Operational Impacts - Biological Environment 296 8/D11
Operational Impacts — Social, Economic, and Cultural Environment 297 8/D13
— Economic Setting 297 8/D13
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298 8/E1
VI.4.1 Unavoidable Adverse Environmental Impacts 298 8/E1
VI.4.2 Mitigation Measures 298 8/E1
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299 8/E3
Short-Term Uses of Man's Environment 299 8/E3
Maintenance or Enhancement of Long-Term Productivity 299 8/E3
Need for the Project 299 8/E3
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302 8/E9
Permanent Changes in Land Features and Land Use 302 8/E9
Biological Systems 302 8/E9
Assimilative Capacity of the Bay 302 8/E9
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302 8/E9
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302 8/E9

VII SOURCES OF INFORMATION

VII.1 REFERENCES 305 8/F1
VII.1.1 Literature Cited in Text 305 8/F1
VII.1.2 Literature Cited in Figures 312 8/G1
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313 8/G3
VII.3 CONTACTS 316 8/G9
VII.4 DISTRIBUTION LIST 335 9/D3
VII.4.1 Federal Agencies 335 9/D3
VII.4.2 Libraries 338 9/D9
VII.4.3 Individuals and Private Groups 339 9/D11
VII.4.4 State Agencies 347 9/E13
VII.4.5 Regional Agencies and Local Government 348 9/F1
VII.4.6 Legislators 352 9/F9
VII.4.7 News Media 353 9/F11

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

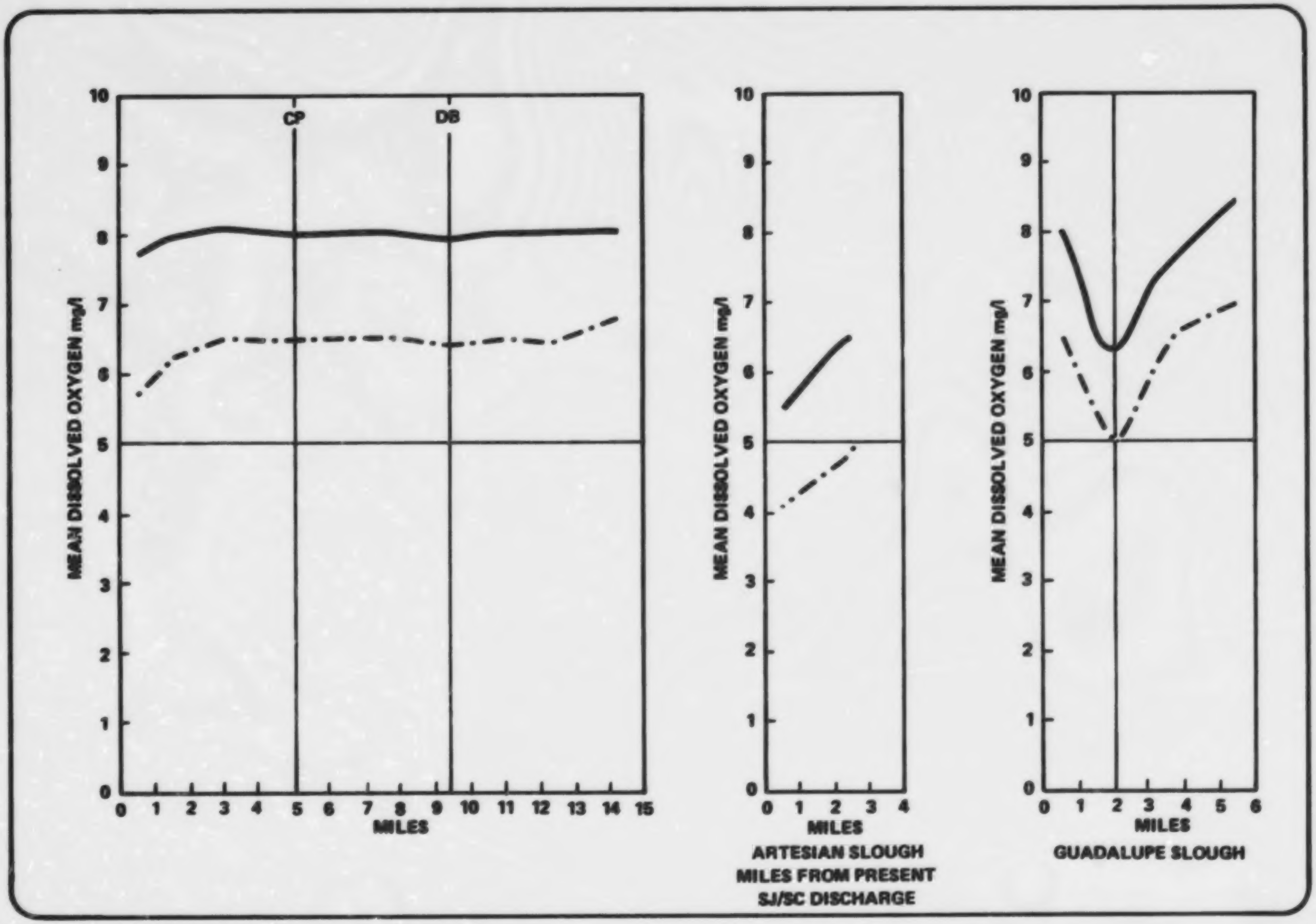


Figure IV-6
WATER QUALITY PARAMETERS ASSOCIATED WITH ALTERNATIVE 3 (HYDROSCIENCE, INC., APPENDIX C)

IV.2.4 ALTERNATIVE 4 — UPGRADED TREATMENT WITH CONTINUED LOCAL DISCHARGE

In this alternative (Figure IV-7), no new conveyance system would be built. Rather, treatment levels would be upgraded beyond the levels currently planned or under construction. Alternative 4 would include continued discharge at the present local disposal sites: headwaters of Artesian Slough for San Jose/Santa Clara, Guadalupe Slough for Sunnyvale, and a dredged channel north of Palo Alto Municipal Airport for Palo Alto.

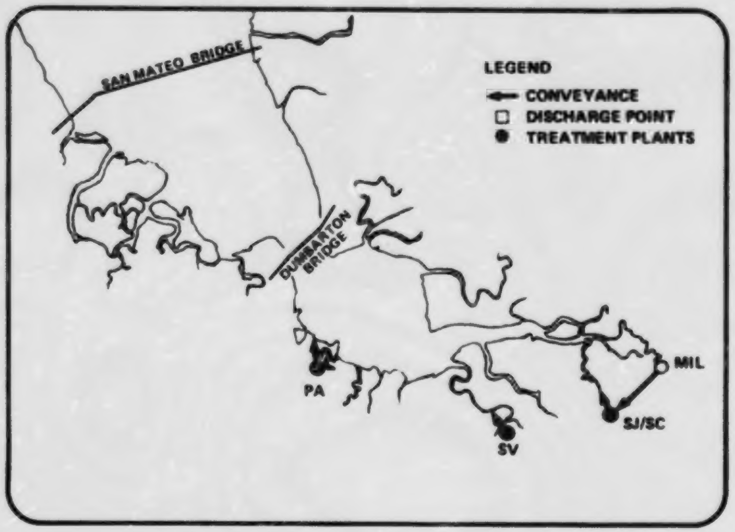
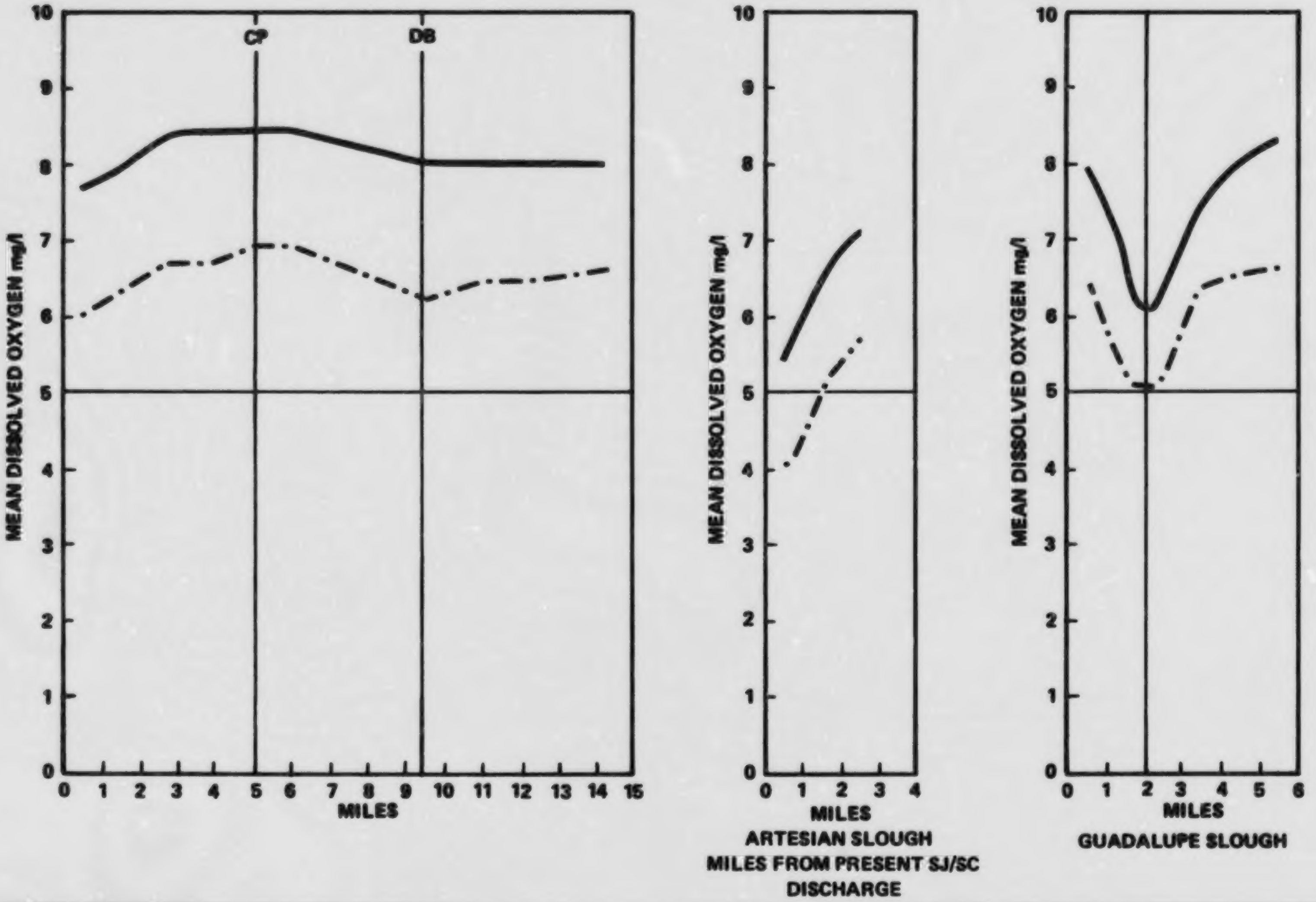


Figure IV-7 SCHEMATIC – ALTERNATIVE 4

This alternative is technically feasible in that advanced treatment can be used to produce a very high quality effluent. This alternative would be of environmental benefit to Artesian Slough, provided that the advanced treatment facilities operated reliably. The freshwater habitat in Artesian Slough would contribute to the diversity in the Alviso portion of the National Wildlife Refuge, establishing an area suitable for breeding waterfowl and other wildlife requiring a source of fresh water.

Since a minimum concentration of 5.0 milligrams per liter (mg/l) dissolved oxygen (DO) is necessary in the waters of the South Bay in order to meet proposed water quality objectives, additional treatment processes would have to be implemented at San Jose/Santa Clara to supplement existing primary and secondary treatment and approved biological nitrification and filtration (Bechtel, 1974). These processes could include residual ammonia removal through breakpoint chlorination and adsorption on activated carbon for further reduction of oxygen-demanding substances and toxicants. No additional treatment upgrading was proposed for Sunnyvale and Palo Alto in this analysis, since it was assumed that presently approved treatment at Palo Alto and Sunnyvale would meet the 5.0 mg/l criterion.

However, by 1985, provision of this upgraded treatment to the anticipated flow of 143 million gallons per day still would result in a calculated oxygen demand discharge to Artesian Slough of 11,000 pounds per day (Bechtel, 1974). This discharge is too large to guarantee maintenance of a minimum DO of 5.0 mg/l in all portions of Artesian Slough (Figure IV-8). Presently approved treatment at Palo Alto would meet the 5.0 mg/l requirement, but continued discharge to Guadalupe Slough would not meet DO requirements. The system does not comply with prohibitions to discharge south of Dumbarton Bridge or to dead-end sloughs. In addition, this system does not comply with minimum 10:1 dilution requirements. Continued discharge to the sloughs would result in a continued loading of toxic materials to the sloughs, with predicted levels of about 400 ml/l, similar to those predicted for no further action (Alternative 2). Continued repression of biological potential may result, as in the no further action alternative. It should be noted that improvement in DO levels for all portions of the Bay are as favorable as those achieved in Alternative 3 and the



CP CALAVERAS POINT
DB DUMBARTON BRIDGE

— · — · · 1985 DRY
——— 1985 WET

Figure IV-8
WATER QUALITY PARAMETERS ASSOCIATED WITH ALTERNATIVE 4 (HYDROSCIENCE, INC., APPENDIX C).

Basin Plan Alternative (Alternative 1), and that upgraded levels of treatment at San Jose/Santa Clara appear to reduce seasonal variation in water quality due to increased waste loading (Appendix C).

The selection of this upgraded treatment alternative would remove the construction impacts associated with Alternative 1, such as the effects of dredging on water quality and on the benthic community from Palo Alto to the discharge point. No construction activity would be required in marsh communities, such as the Palo Alto Baylands Reserve and salt marsh.

Construction impacts would result from the expansion of treatment facilities at San Jose/Santa Clara. These impacts would include the clearing and grading of land for expansion and the resultant noise and dust generation. These impacts would be localized, occurring only at the treatment plant site(s), and would last only during construction.

This system would require the addition of a common conveyance should large-scale reclamation be implemented at a future date. For this reason, Alternative 4 is considered to be less compatible with reclamation and reuse options than other, regionalized alternative systems, although the treatment levels may actually be more compatible than other alternatives.

Continued discharge of treated wastewater effluent to waters of San Francisco Bay south of Dumbarton Bridge is contrary to the present policy of the State of California. *The Water Quality Control Policy for the Enclosed Bays and Estuaries of California* (SWRCB, 1974) recommends elimination of such discharges at the earliest possible date. However, where it can be demonstrated that environmental benefits will be derived as a result of the discharge, phased construction and a detailed monitoring program to identify changes if any in water quality may be implemented, subject to the approval of the state and regional boards. If the alternative of continued discharge of highly treated effluent did not meet criteria in the extremities of the Bay or did not provide environmental benefit, the construction of a regionalized conveyance system in the future would still be necessary.

The cost of construction and operation of an upgraded treatment alternative would be approximately 135 percent of that proposed for a conveyance to a discharge point just north of Dumbarton Bridge (Alternative 1), or 116 million dollars. In addition, annual consumption of energy and chemicals for facility operation would be much greater than for the Basin Plan Alternative.

Result of Screening

The potential benefit to Bay water quality, particularly in the southern extremities of the Bay and in the National Wildlife Refuge, makes this alternative a viable disposal system. Should phased programs with monitoring be proposed and approved by the Regional Water Quality Control Board, such an alternative could be considered as the first phase in a reclamation program or in a future disposal program.

IV.2.5 ALTERNATIVE 5 — RECLAMATION AND REUSE

The policies of the State of California (SWRCB, 1974 and 1977) and the U.S. Environmental Protection Agency (1975) are to give primary consideration to those wastewater disposal alternatives that offer the greater degree of flexibility for the implementation of wastewater reclamation. Alternative 5 (Figure IV-9) was considered from two viewpoints: near-term reclamation and reuse for all of the wastewater, and reclamation and reuse at some future date, a decision kept open by selecting a disposal system for installation now that has flexibility for alteration later. The first viewpoint is reviewed below; the feasibility of each of the other general disposal alternatives in regard to future alteration is discussed in their respective subsections. In addition, reclamation and reuse of a small portion of the wastewater is considered in detail in Section V as a wastewater management option rather than as an alternative to disposal.

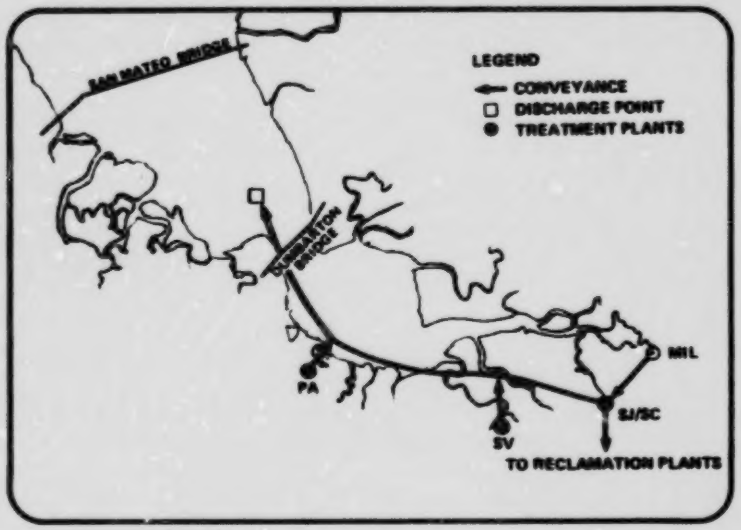


Figure IV-9 SCHEMATIC – ALTERNATIVE 5

The major benefits of reclamation and reuse include the conservation of water resources. In "water-short" areas (i.e., areas that must import water to meet demand) such as the San Francisco Bay Area, the costs of developing new water supplies are increasing. In addition, during drought years, such as the 1976-1977 water years, these imported water supplies are tenuous at best and severe restrictions may be placed on their use. Imported waters are, in effect, an exhaustable resource. Treatment of wastewater and implementation of a reuse program can reduce the overall demand for imported water. In this manner, the available water supply can be used to supply the greatest number of consumers more efficiently.

Reclamation and reuse pose a number of problems that have made widespread implementation unacceptable in the past. These include:

- The cost of treatment. Reclamation plants often treat wastewater to a higher degree than that usually used by treatment agencies. The level of treatment used (when the water is put to uses where there is a high degree of public exposure) consumes large quantities of energy and chemicals per gallon of treated water with only small incremental improvements in water quality. These costs are reflected in high prices charged to consumers for reclaimed water or in subsidies of treatment by the taxpayer.

- The efficiency of treatment. A number of components of wastewater are conservative; that is, these elements do not break down or decay but accumulate in natural systems. Nitrates, dissolved salts, and heavy metals, for example, require costly methods of treatment to reduce their concentrations in reclaimed water to levels acceptable to agricultural and industrial consumers. In some instances, treatment to acceptable levels is technically feasible; in others, where quantities of conservative elements are particularly high, treatment is not economically feasible. In these latter instances, effective source control is necessary, and reliability of treatment must be assured.

- The impacts of reuse. Nitrates and dissolved salts, trace organic materials, and viruses may build up in groundwater supplies recharged with reclaimed water. Body contact recreation and consumption of fish and shellfish may be restricted in bodies of water receiving supplemental flows from reclaimed water. Certain crop species are sensitive to elements such as boron in reclaimed water; other crops such as leafy vegetables may not be irrigated with reclaimed water and sold for human consumption because of the potential for bacterial or viral contamination. Standards have been established that are appropriate for all the above conditions.

- The problem of public acceptance. Even in instances where the above problems can be mitigated or avoided, the public may be resistant to accepting reclamation of wastewater as a general practice. The source of the water supply is often considered unacceptable, regardless of treatment or the problems of supply of more acceptable waters.

In view of the increasing value of good quality water supplies, the high economic and environmental costs of diversion, and the dwindling sources of good quality water in the South Bay, reclamation and reuse must be considered.

Reclamation in Santa Clara County

In 1973, the Santa Clara County Flood Control and Water District engaged Consoer-Bechtel to perform a survey of the significant potential uses of reclaimed water within the district and in adjacent areas and to identify the relative merits of using reclaimed wastewater. This study also evaluated the effect of the use of reclaimed water on alternative water supply systems. The eight markets identified for reclaimed water are shown in Table IV-1.

The Consoer-Bechtel (1973) study determined that the best markets for reuse were groundwater recharge by percolation or injection in north Santa Clara County and export to the south for recharge and irrigation. Assuming increased treatment for the removal of nitrates and TDS, nine alternative programs for reclamation, which included the Basin Plan Alternative, were proposed and analyzed (Table IV-2). Consoer-Bechtel (1973) could not find clear technical or economic reasons for a choice between a San Felipe Project of 400,000 acre-feet (present proposed maximum delivery is 145,000 in 2000) for the use of state water in Santa Clara County and the use of reclaimed water. While costs to the San Felipe service area and to the Santa Clara County Flood Control and Water District would be higher for reclamation than for the San Felipe Project, total costs without federal subsidies and controls and near-term capital costs would be less for reclamation. Consoer-Bechtel (1973) also concluded that the market was not large enough for both reclamation and the San Felipe Project; the construction of the San Felipe Project "virtually eliminates the need" for large-scale reclamation.

The use of any one of the alternative reclamation programs considered does not preclude the need for a disposal system for South Bay Discharger wastewater. The disposal system could be sized for smaller flows in all reclamation alternatives, but could not be totally eliminated.

Table IV-1

RECLAMATION AND REUSE MARKETS IDENTIFIED
BY CONSOER-BECHTEL (1973)

Market and Quantity	Comments
Percolation in Santa Clara County — 150,000 to 290,000 acre-feet/year	Because of the extensive conveyance and percolation facilities, this market is not seasonal. The nitrate and TDS content of groundwater basin must be considered.
Injection in Santa Clara County — at least 75,000 acre-feet/year	Also a continuous market. Some question of the capability of the basin to transfer water. Nitrate and TDS must be considered as well as turbidity and growth potential of injected water.
Agricultural irrigation in Santa Clara County — 95,000 acre-feet now, 58,000 by year 2000	This demand is now satisfied almost exclusively by groundwater, especially in the north county. It can be considered a recharge market. Direct surface irrigation would be seasonal and, therefore, difficult to meet without extensive storage.

Table IV-1 (Continued)

Market and Quantity	Comments
Nonagricultural small-scale irrigation in Santa Clara County — 15,000 acre-feet/year	These markets are all small, seasonal, and widely distributed
Open space irrigation — virtually unlimited	It is questionable that this is a true market as opposed to a means of disposal. If it is a market, it represents a "created" market in an area that is already facing a water shortage.
Industrial reuse — very small	No large water-using industries exist or are planned for the area with the exception of canneries. Canneries are a poor market for public health reasons. Also, the canneries may ultimately leave the county.
Reservoir augmentation — small	A possible future market, but difficult to justify compared to percolation, injection, or export to the south county.
Export to south county and areas to the south — 63 mgd	Assumed as a virtually continuous demand for groundwater recharge. Nitrate and TDS must be considered.

The time for implementation of any one of the reclamation and reuse alternatives was estimated to be longer than that for the San Felipe Project (later than 1980) and would come too late to meet discharge restrictions for South San Francisco Bay. In addition, there is a need for a means of disposing of the wastewater during periods when it is not needed or during periods of treatment upset. Therefore, while a common conveyance project does include the potential for eventual incorporation into a large-scale regional reclamation and reuse program, reclamation and reuse does not preclude the requirement for a disposal system.

The use of reclaimed wastewater for groundwater recharge and surface irrigation is subject to a number of constraints. The water must be treated to meet a number of factors, including short-term effects on crop quality and effects on intended crop use. In addition, these effects are a function of soil, crop, and water characteristics, including rate and pattern of reclaimed water application and the depth of the water table (Schmidt, Kugelman, and Clements, 1975). Any failure in the treatment system could result in a potential violation of recommended standards, requiring that a bypass pipeline be incorporated into project design to direct flow away from the reclamation plant.

For this reason, the construction of a reclamation-reuse project for South Bay Dischargers Authority wastewater would not substantially reduce the construction impacts on the South Bay environment from those expected for any disposal project, since construction of a reclamation/reuse facility would not substantially reduce disposal pipe diameters. The area disturbed would be more dependent on soil conditions and the actual route chosen for the disposal conveyance than on the size of the pipe. Impacts on water quality, biota, and area residents would be similar to those projected for the Basin Plan Alternative and would be short-term, local, and reversible.

Additionally, impacts would result from the construction of a regional reclaimed water conveyance system to the reuse markets. These impacts would vary somewhat with the choice of market and conveyance, but would all be related to clearing and grading of a right-of-way, trenching and backfilling, crossing streams or roads, and working near residences and other developed areas.

Table IV-2

RECLAMATION ALTERNATIVES EVALUATED
BY CONSOER-BECHTEL (1973)

IA	Reclaimed water from Palo Alto, San Jose/Santa Clara, and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County and surface irrigation in south county.
IB	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County and surface irrigation in south county.
2	Reclaimed water from Palo Alto and "up sewer" reclamation plants to be used for percolation in north Santa Clara County.
3	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for injection in north Santa Clara County and surface irrigation in south county.
4A	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County and in Coyote Basin.
4B	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for injection in north Santa Clara County and percolation in Coyote Basin.
5A	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for percolation in north Santa Clara County and Coyote Basin; San Felipe Project implemented for south county.
5B	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for percolation in north Santa Clara county; San Felipe Project implemented for south county.
5C	Reclaimed water from San Jose/Santa Clara and Gilroy/Morgan Hill to be used for injection in north Santa Clara County; San Felipe implemented for south county.

The discharge of wastewater to San Francisco Bay could be decreased by as much as 67 million gallons per day; the improvement in Bay water quality would be proportional to this decrease if no additional treatment were initiated. If the treatment procedures necessary to make reclamation acceptable to the public were implemented, the water quality of San Francisco Bay might improve at a rate higher than presently expected.

The direct use of reclaimed water in Santa Clara County for agricultural irrigation would have several potential impacts. These include potential limitations on the type of crop that could be irrigated, since many crops grown for human consumption are sensitive to contaminants in wastewater. Additionally, crops that can be effectively irrigated with treated wastewater generally return less dollars per acre than the other crop types. This results in an economic hardship to the landowner, particularly in a rapidly urbanizing area such as the Santa Clara Valley where costs, including property taxes, are high. A more detailed discussion of these and other effects of limited reclamation for agriculture is presented in Section V.

Operation of upgraded treatment facilities would result in an increase in the consumption of chemicals and energy over that currently projected for the treatment plants. Estimated annual costs without grant funding for construction and operation of a 67 million gallon per day facility would be approximately 380 percent of the Basin Plan Alternative (327 million dollars), not including expected returns from the sale of the reclaimed water. These costs of improved treatment for reclamation and a conveyance would be added to the costs for a conveyance of reduced capacity to San Francisco Bay. This 67 mgd facility would not preclude smaller local reuse projects, which could further decrease the amount of effluent discharged to the Bay. Such projects are described below.

Smaller Reuse Markets in the Service Area

Consoer-Bechtel (1972) analyzed a number of smaller reuse markets, using the Palo Alto area as an example. Each of these markets is equally applicable to the San Jose/Santa Clara and Sunnyvale areas. While none of these markets would utilize a large portion of SBDA wastewater, they could be used as a supplement to a larger reclamation program or to a disposal system.

These Palo Alto markets included irrigation of open space of 5,800 acres (10 mgd, spray irrigation), supplying water to a Baylands lake project of 570 acres, and direct municipal reuse. All of these reuse markets have public health constraints and, in some instances, would require upgrading of treatment.

Irrigation of open space in Palo Alto would be seasonal, occurring only for six months of the year. The remaining flows would require storage capacity in existing (Arastradero Creek) or new reservoirs. A conveyance system to the storage reservoir and a spray irrigation system would have to be constructed in addition to a disposal conveyance for SBDA and for any major reclamation projects. This market would be a "created" market, not replacing any current or projected water use and therefore not reducing consumptive use of imported or local water supplies. However, irrigation of open space could be a worthwhile potential market for reclaimed wastewater.

The creation of a Baylands lake in Palo Alto would involve the flooding of an area as large as the Santa Clara County Flood Control Basin and Salt Pond A-1, as well as possible utilization of Salt Pond A-2W. These lakes would be used for non-body contact recreation during the dry season. During the wet season, the lakes would be used for flood control and would have to be emptied of the wastewater effluent. Such a program would preclude current uses of this or similar areas in the salt-evaporator system and would require reexamination of the proposed development of a nature park in the Palo Alto Baylands Reserve. In addition, this project would not affect the water supply of the area, since it would also be a "created" market. Remaining effluent flows would still require a conveyance system to a discharge point in the Bay, and the reclaimed effluent would still have to be disposed of when the lakes are to be emptied for flood control.

Direct domestic reuse in Palo Alto would require upgraded treatment, possibly including reverse osmosis, lime precipitation, ammonia stripping, activated-carbon absorption, and a prohibition of the discharge of home water-softener brines to the sewerage system (no process or quality standards have yet been promulgated for direct domestic reuse). Such upgraded treatment would be costly, would greatly increase the cost of water to the consumer, and would not remove the requirement for a discharge conveyance for San Jose/Santa Clara and Sunnyvale flows. Direct use does not have the approval of the State Department of Public Health, the local health department, or the EPA, and such reuse would not be readily acceptable to the taxpayer and consumer. No responsible authority in the U.S. has approved direct reuse.

As stated earlier, other similar reuse markets can be identified in the service areas of each regional treatment plant. These reuse markets could also be utilized in conjunction with the proposed project or a regional reclamation plan and would be subject to the same problems of public acceptance and treatment costs as those described for Palo Alto markets. Upgraded treatment could be implemented for all flows from any one facility or for only a fraction of the flows, minimizing the cost of local small-scale reclamation.

In April 1973 and in October 1974, Jenks and Adamson prepared a study for a wastewater reclamation pilot program for the Santa Clara Valley Water District. The facility, approved for funding in September 1975, would consist of a 4 million gallon per day reclamation plant supplied with effluent from the Palo Alto treatment plant. A groundwater recharge program limited to the purpose of providing a limited saltwater intrusion barrier and an open space irrigation program will be implemented. In 1976, the Santa Clara Valley Water District initiated market studies and engineering and environmental planning for a 2 mgd reclamation facility to be located either at San Jose/Santa Clara or at Milpitas. Agricultural and industrial use is the ultimate goal of this pilot project. Other similar studies have been proposed by San Jose/Santa Clara, Gilroy, and Morgan Hill, although they have not yet been initiated. Twenty-five reclamation projects, ranging in size from 430 to 20,000 acre-feet a year are listed on the Clean

Water Grant Program Priority List for fiscal year 1978-79 (SWRCB, 1978) but have not yet completed their planning efforts. Should these programs prove successful, the intrusion barrier may be extended around the entire South Bay, open space irrigation could be offered for such uses as city parks and highway median strips, and agricultural/industrial reuse could be initiated.

Markets Outside the Service Area

A number of potential markets for reclaimed water have been identified outside the SBDA service area (Consoer-Bechtel, 1972). These include power plant cooling and export for use in the San Joaquin Valley. Other markets have been identified by the Department of Water Resources (1974).

The use of treated wastewater in power plant or industrial cooling systems has been implemented in several areas of the country. Weddle and Masri (1972) list eight power plants, seven petroleum refineries, eight mining facilities, two chemical companies, and one manufacturing firm that use reclaimed wastewater for cooling, boiler feed, oil well flooding, or other process makeup. Similarly, Schmidt, Kugelman, and Clements (1975) have identified 153 reuse operations; 40 percent of the U.S. volume of reclaimed water was consumed by industries for boiler feed and process or cooling water. The use of 1,000 million gallons per day of reclaimed water for a 1,000-megawatt power plant in the Central Valley of California, for example (DWR, 1974), would result in a significant beneficial impact on existing water resources. The California Department of Water Resources (1974) indicated that, although water quality requirements for power plant cooling water are strict, municipal wastewater can and has been used extensively for this purpose. Should reclamation for power plant cooling be implemented in the future, SBDA wastewater and other Bay area wastewater would be sufficient to satisfy the needs of northern California. However, such large-scale reclamation and reuse is dependent on construction of power plants near the wastewater source. With no power plants present or planned, the immediate water quality problems of South San Francisco Bay cannot be met with such a system. For this reason, reuse of SBDA wastewater in power plants can only be considered as a future option and is not analyzed further in this study.

Treated wastewater could be transported to the Central Valley for reuse via a combination of existing and proposed canal and storage systems. One such system is the Delta-Mendota Canal, a Bureau of Reclamation facility, which transports water from the Sacramento-San Joaquin River Delta to the San Joaquin Valley for agricultural use. Summer flows in 1972 (Consoer-Bechtel, 1972) were 4,200 cubic feet per second (2,700 mgd) with a design capacity of 4,600 cubic feet per second (3,000 mgd). A portion of the water is used for irrigation in the San Joaquin Valley, and the remaining water is mixed with State Water Project water at San Luis Reservoir for export further south.

In order to discharge to the Delta-Mendota System and meet government restrictions on such discharge, the canal might have to be physically separated from the State Water Project and an alternative domestic water supply for Dos Palos provided. A conveyance system from the SBDA service area still would have to be constructed to allow bypass in the event of treatment upset. Increased construction activity would result in a number of impacts between San Jose and the canal, which is located about 16 miles east of Livermore, California. These impacts would include clearing and trenching in coastal mountain habitats, such as oak grasslands; crossing of a number of streams and roads; and noise, dust, and limitation of access locally.

Use of this reclamation/reuse system could remove an effluent discharge from San Francisco Bay. The proposed use of wastewater in the Delta-Mendota Canal, however, might meet with problems of public acceptance similar to those identified for other markets. Reclaimed water is more expensive, poses problems related to public health, and may not be mixed with water to be used directly for human consumption. The purchasers of Delta-Mendota water would be limited by these concerns and might prefer the purchase of state water presenting fewer problems. Therefore, while export of reclaimed water to the San Joaquin Valley would reduce the pressure for additional transfers of state water to a water-short area and would fulfill a real need, the problem of public acceptance and State Health Department approval of such use has not been resolved.

Result of Screening

The limited market available for reclaimed water, the availability of other sources of high quality water at cheaper subsidized prices, the lack of an implementing agency for Bay Area reclamation, and the time-scale necessary for implementation of reclamation limit the viability of this alternative. In addition, technological constraints and public health concerns limit implementation of large-scale reclamation. For these reasons, reclamation was determined to be a viable option only to the extent that it might be included in present and future water management plans rather than as an alternative disposal plan. One such aspect of a water management plan — use of reclaimed water for agricultural irrigation in Santa Clara and San Benito Counties — is discussed in detail in Section V of this EIR/EIS.

IV.2.6 ALTERNATIVE 6 — CONSOLIDATION WITH OTHER DISCHARGER AUTHORITIES WITH A SINGLE OUTFALL NORTH OF SAN MATEO BRIDGE

Alternative 6 requires consolidation with other discharger authorities, such as the South Bayshore group in San Mateo County. The new discharger authority would then construct a pipeline for discharge of combined effluents north of San Mateo Bridge (Figure IV-10). This alternative is technically feasible and would deliver wastewater with the required dissolved oxygen requirements at the discharge point, removing a source of toxic substances and oxygen demand from south of the Dumbarton Bridge. Dilution of conservative toxic elements will be of particular benefit to the Bay water quality. While this alternative will meet all water quality requirements, including toxicity, it will result in forfeiture of investments in all currently approved facilities, studies, and plans. Physical structures that would have to be abandoned include three relatively new and costly deep water outfalls. Initiation of negotiations will require at least one year, delaying implementation of a disposal scheme.

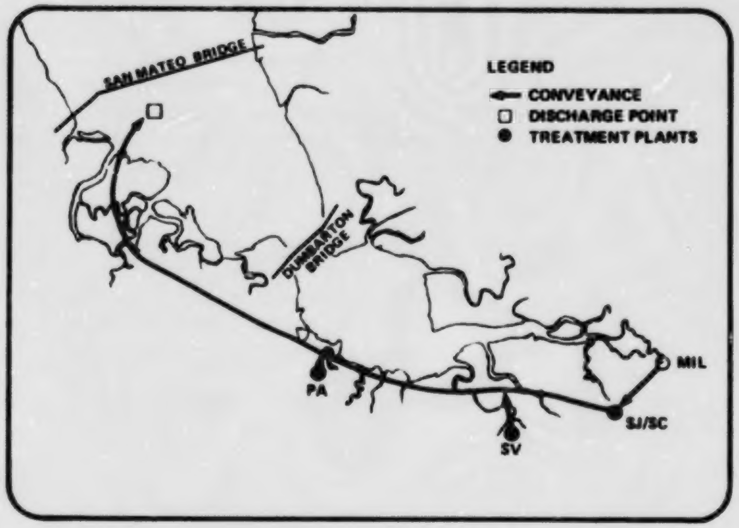


Figure IV-10 SCHEMATIC – ALTERNATIVE 6

Environmental impacts associated with this alternative include construction in the San Francisco Bay National Wildlife Refuge north of the Dumbarton Straits and in the vicinity of the University Village archaeological site (see Section IV.2.1). Construction across mud flats and open water north to the disposal point would affect a greater portion of San Francisco Bay than construction of a conveyance ending north of Dumbarton Bridge. The effects of this activity would be short-term, including local degradation of water quality, removal of benthic organisms during dredging, and the need for disposal of large quantities of dredge spoils. Additionally, construction along a connector between Palo Alto and San Mateo County could affect the University Village archaeological site.

The increased construction requirements would result in a significant increase in the consumption of energy and materials during construction due to the length of such an alternative. This would be reflected in the construction costs of the alternative. In addition, capital costs for such a consolidated facility would be greater for a small improvement in water quality. Estimated capital, operating, and maintenance costs for this alternative are 190 percent of those estimated for the Basin Plan Alternative (about 164 million dollars). Should the conveyance be used by other discharger authorities, the cost to SBDA would be some fraction of this increased cost, depending on the agreements to be made by the participants. The cost of abandoning existing outfalls recently approved for the northern dischargers was not included in the estimate of cost.

The consolidation of discharges on the west side of the Bay would be compatible with future large-scale reclamation and reuse projects, should such a program be proposed.

Result of Screening

Alternative 6 was determined to be nonviable because of the time constraints on implementation and the necessary forfeiture of investments in facilities and approved plans. Biological impacts in the National Wildlife Refuge and additional portions of the Bay and potential archaeological impacts in the University Village area are other disadvantages of this alternative. In addition, dissolved oxygen levels in the Bay would not be significantly improved, in comparison with the Basin Plan Alternative (Bechtel, 1973), for costs expended.

IV.2.7 ALTERNATIVE 7 – DISCHARGE TO THE OCEAN

As shown in Figure IV-11, the alternative of ocean discharge would consist of an onshore pipeline from San Jose/Santa Clara and Sunnyvale to Palo Alto. From the Palo Alto treatment plant, the effluent would be conveyed to the Pacific Ocean via a pipeline and tunnel through the Santa Cruz Mountains. The outfall would enter the ocean at a point about 6 miles south of Half Moon Bay and would extend into the ocean approximately 7 miles, to a depth of 200 feet. At this location, an initial dilution factor of greater than 100:1 could be achieved, and the plume would not be transported back into San Francisco Bay by the coastal currents or tides.

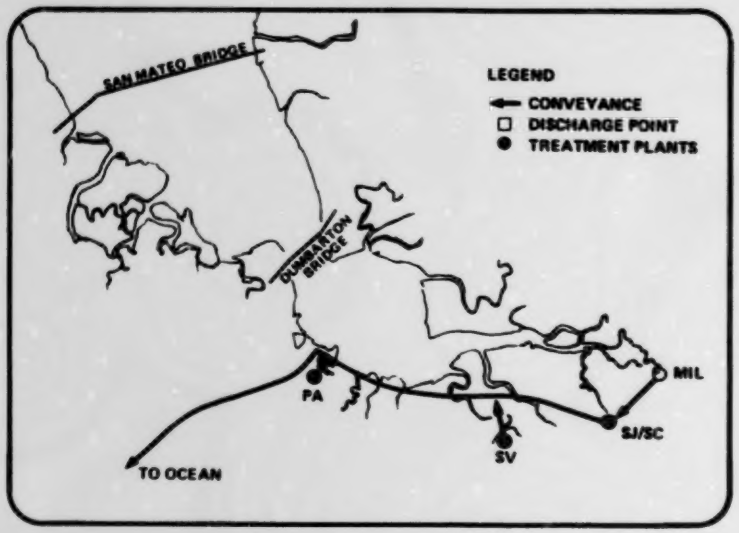


Figure IV-11 SCHEMATIC – ALTERNATIVE 7

Alternative 7 would remove the SBDA discharge from San Francisco Bay, allowing recovery of the Bay from current and projected discharges. The SWRCB (1972, as amended 1977) plan for ocean discharge would be met by this alternative with the implementation of currently planned treatment upgrading.

Construction impacts would be removed from the Bay environment for the area from Palo Alto north. Additional construction impacts, however, would result from the construction of a conveyance and tunnel through downtown Palo Alto and the Santa Cruz Mountains. These additional impacts would include clearing the right-of-way and trench construction between Palo Alto and the ocean discharge point. Portions of terrestrial habitat near Palo Alto and near the coast would also be affected, as would approximately 7 square miles of ocean bottom. The degree of impact would depend on the length of the tunnel portion of the conveyance and the time necessary for recovery of the area after cessation of construction activities.

The major technical constraint in a conceptualized ocean discharge system is the tunnel through the Santa Cruz Mountains, which would require crossing the San Andreas fault zone. While it is technically possible to build such a tunnel, this area of seismic activity would pose a continual threat to the integrity of the conveyance system. Under less severe seismic conditions, cracks in the tunnel and subsequent release of the treated wastewater to surrounding groundwater could result. A major earthquake could result in blockage of the conveyance system, requiring a bypass of the wastewater to San Francisco Bay south of Dumbarton Bridge.

While discharge to the ocean would remove effluents from San Francisco Bay, resulting in maximum potential for improvement in Bay water quality, this removal of freshwater flows from the South Bay would affect flushing at the South Bay sloughs and reduce the potential for habitat diversity in the wildlife refuge. Further, local degradation of ocean water quality would result. Although this degradation is not in violation of ocean discharge requirements, there is a growing awareness of the limits of the assimilative capacity of coastal marine waters, as well as enclosed bays and estuaries.

The cost of an ocean conveyance, including construction of that portion of the conveyance from San Jose/Santa Clara to Palo Alto, is estimated to be approximately 271 percent of that of the Basin Plan Alternative (233 million dollars). Because of the size of the system and investment, it would be difficult to justify abandonment of the segments from Palo Alto to the ocean if large-scale reclamation should become feasible.

Result of Screening

The primary reasons for determining that this alternative is less acceptable than the Basin Plan Alternative are the potential adverse effects on ocean water quality, the extent of construction impacts, the environmental impacts that might result from seismic activity, and the associated cost.

IV.2.8 ALTERNATIVE 8 — LAND DISPOSAL

In Alternative 8 (Figure IV-12), treated wastewater is conveyed to a disposal site where it is applied to the land. The soil mantle and vegetative cover act as a filter, removing pollutants. Oxygen-demanding substances are oxidized, nitrogen and phosphorous are assimilated by plants, and heavy metals are adsorbed on soil particles. The vegetative cover is periodically harvested to prevent the recycling of assimilated nutrients through the plant decay process. The vegetative cover could be a salable crop, under controlled conditions.

Specific requirements in the selection of an appropriate land disposal site include areas with low population density and minimum projected growth, areas of sufficient acreage and even topography with soils conducive

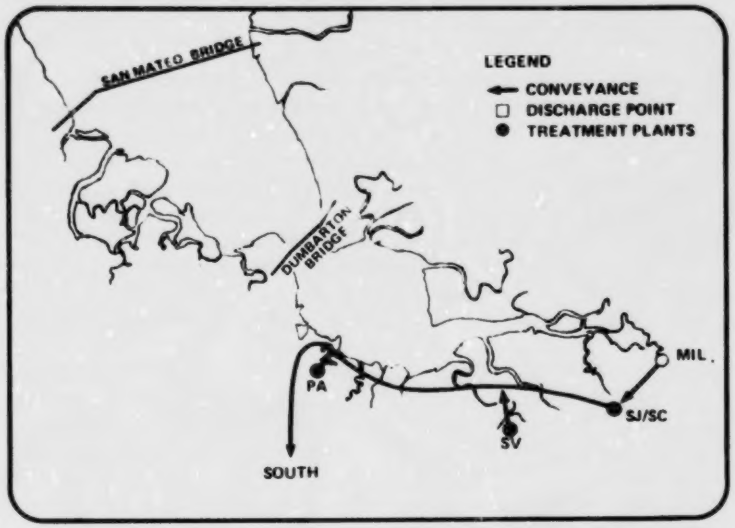


Figure IV-12 SCHEMATIC – ALTERNATIVE 8

to infiltration, and areas where treated wastewater could not contaminate groundwater reservoirs. The U.S. Army Corps of Engineers (1975) conducted a study of alternative programs of land application of wastewater in the San Francisco Bay area. They applied the additional criterion that a suitable disposal area would have to be lower than 1,500 feet elevation to eliminate the need for extreme pumping heads necessary for disposal in higher areas. The study identified two sites in the South Bay area: a small site in San Mateo County near Half Moon Bay and a larger site in Monterey County east of Salinas. No sites were identified in Santa Clara County, because most of the area suitable for disposal drains to surface or groundwater reservoirs currently used for municipal water supplies.

The area at Half Moon Bay is too small to accept all of the projected 1985 flows from SBDA, requiring ocean disposal of the excess. The area in Monterey County could accommodate full flows expected in the year 2000. However, due to the strong objections of the citizens of Monterey County to the use of their land for disposal of wastewater from other counties, the Corps designated this site to be of secondary consideration. If these objections could be overcome, this would be the only suitable land disposal site available to the South Bay Dischargers.

In order to implement a land disposal alternative, a conveyance system suitable for transport of wastewater (90% of projected year 2000 flows was used for cost estimation) from the treatment plants to Monterey County would have to be constructed. The cost of pumping the effluent to Monterey County would include increased consumption of energy. Construction and operation of this conveyance system and ancillary facilities, such as distribution and drainage facilities and temporary storage, would cost approximately 845 percent of the cost of the Basin Plan Alternative (about 728 million dollars).

The system and its ancillary facilities would require clearing and grading of a right-of-way from Palo Alto, south to Monterey County, the construction of a storage reservoir for use during the wet season, and a dispersal system at the disposal site. Short-term disruption of terrestrial habitat during construction and the loss of an undetermined acreage of habitat due to flooding of the reservoir would result. Construction would also result in noise, dust, and restricted public access locally.

Land disposal of the effluent would pose some public health problems, such as the survival of pathogenic bacteria and viruses, the percolation of nitrates and organic compounds into the groundwater, the accumulation of heavy metals in the soils, and the propogation of pest species such as insects (Metcalf and Eddy, 1975). These problems would limit the value of the potential disposal site as an agricultural or recreational area. Only certain crops could be grown on the site, and spray irrigation of a recreational area would have to be scheduled for times of minimum public use. In addition, the multiple use of storage facilities would be limited, with body contact recreation prohibited, unless adequate treatment were provided.

Changes in groundwater and surface water quality could result, particularly increases in the concentration of nitrate nitrogen. Groundwater levels might also rise, potentially resulting in seeps, perched water tables, and other high-water problems (Metcalf and Eddy, 1975).

Some changes in soil quality parameters, such as salt concentrations, levels of various elements, pH, and cation exchange capacity, could also result (Metcalf and Eddy, 1975). These factors would have to be monitored and corrective measures taken in order to minimize the impact of land disposal.

Result of Screening

The extreme costs of conveying SBDA wastewater to a marginally suitable land disposal site in Monterey County are probably not justifiable for the benefits gained from eliminating discharge to the South Bay. It is highly questionable whether such a program would be acceptable in Monterey County, and no suitable alternative site is available.

IV.2.9 ALTERNATIVE 9 — NONSTRUCTURAL WASTEWATER MANAGEMENT CONSIDERATIONS

In examining project alternatives, the EPA is required to consider procedures that might eliminate the need for the project or delay its implementation until actually needed. These considerations are a part of nonstructural wastewater management. Nonstructural provisions for wastewater management include the phasing of facility construction to provide only the facilities presently needed, developing and enforcing land-use plans to reduce wastewater flows at the source, and developing and enforcing environmental protection regulations. These provisions, while applicable to the determination of treatment level and treatment capacity for existing or proposed facilities, are not completely or readily applicable to the disposal of treated wastewater. The proposed treatment plant expansions and upgrading by the member facilities of SBDA have been approved through the issuance of a negative declaration based on the Consoer-Bechtel (1972), Bechtel (1974), Consoer-Townsend (1974), and Brown and Caldwell (1974) reports. The proposed and alternative conveyances are simply means for disposal of the effluent produced by these treatment facilities. Stated another way, many of the nonstructural wastewater management decisions related to the functioning of SBDA, including phasing of construction and land-use planning, have already been explored and resolved.

The proposal of a common conveyance system to a discharge point north of Dumbarton Bridge was based on the promulgation of environmentally protective regulations, such as *The Water Quality Control Policy for Enclosed Bays and Estuaries of California* (SWRCB, 1974), *Water Quality Control Plan, San Francisco Bay Basin* (SWRCB and RWQCB, 1975), and the *Federal Water Pollution Control Act of 1972* (Appendix L). The potential for location of the discharge at other points in San Francisco Bay and at points outside the Bay have been discussed in Section IV.

Promulgation of land-use plans or regulations would affect pipeline construction, since the designation of the permitted uses of permanent easements must be compatible with these plans and regulations. The chosen route, and alternative alignments to discharge points within the Bay, were studied with such constraints in mind, and conflicts were minimized. Since no permanent structures may be built over the pipeline, care was taken to locate alternative alignments in established transportation or utility corridors and in areas designated as permanent open space. Other alternatives affected by land-use planning would be those requiring large acreages of open land for reuse or for land disposal. These areas would have to remain as open space with designated uses compatible with the use of treated wastewater.

Result of Screening

Because the problem of disposal of treated wastewater and alternative methods proposed for this disposal are part of a staged program designed in response to environmental regulations and land-use plans, an alternative of nonstructural wastewater management is not a true "alternative" in the case of the conveyance. Rather, nonstructural wastewater management is an ancillary program. Ongoing analyses by the California Department of Water Resources, the Santa Clara Valley Water District, and other agencies on water conservation will affect the chosen alternative. For this reason, no further separate analysis of nonstructural wastewater management was made in this study. Each viable alternative was analyzed with respect to this concept, however.

Section V

RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION

207-A V

V.1

INTRODUCTION

In Sections I.2 and IV.2, reclamation and reuse of South Bay Dischargers Authority (SBDA) wastewater was considered as an alternative to disposal. It was concluded that reclamation is not a totally acceptable alternative to disposal, since there is only a limited market that cannot accommodate the quantity of treated effluent expected from the three treatment plants and development of a complete market is not likely in the near future.

Local reclamation using small quantities of wastewater is in the planning stage at Palo Alto (4 mgd) and Milpitas (2 mgd), and the State of California Department of Water Resources (DWR) and the Santa Clara Valley Water District (SCVWD) are studying the feasibility of reclamation as a supplementary water supply for the San Felipe Project; a preliminary study of this feasibility was issued in draft form in early 1977 (California DWR, 1977). Several state agencies have issued policy statements declaring their strong support for wastewater relamation (California Fish and Game Department, 1977; California RWQCB, 1977; ABAG, 1977 a and b; SWRCB, 1978; SWRCB and Department of Health, 1977). Several Clean Water Grant Programs for reclamation are currently underway in the Bay Area (SWRCB, 1978); these include:

- The Sonoma Valley Project: 1,110 to 2,800 acre-feet for irrigation of vineyards and feed and fodder crops
- The City of Santa Rosa Project: 6.5 mgd for irrigation of pasture and fodder crops
- The Central Contra Costs County Sanitation District Project: 30 mgd for industrial cooling, washdown, and fire protection

Although reclamation is not a viable disposal alternative because there is not a complete market for all reclaimed water, small-scale and local reuse of portions of the effluent may be viewed as options of wastewater management which are compatible with many of the disposal alternatives studied in this impact statement.

In view of the requirement in Public Laws 92-500 (Federal Water Pollution Control Act Amendments of 1972 — see Appendix L) and 95-217 (Clean Water Act of 1977) and the legislative history of that law, the Environmental Protection Agency feels that full consideration of reclamation and reuse of wastewater is required in this impact statement, and that such full consideration should include optional wastewater management plans that utilize some portion of the treated effluent.

The purpose of this study is to determine the costs of reclaiming a portion of the SBDA effluent for use as agricultural irrigation water in Santa Clara and San Benito Counties. It is postulated that such reclamation may provide the following benefits: a reduction in SBDA wastewater disposal costs, a reduction in the adverse effects of wastewater discharge on the Bay, and an increase in the amount of irrigation water available for agriculture in the study area. Such an increase is intended to alleviate groundwater depletion problems, increase agricultural productivity, decrease the overall cost of irrigation water, reduce demands on other water supplies (e.g., Delta water as supplied by San Felipe), and/or open up additional land for irrigation.

The analysis in this section was based on, and intended as a supplement to, the State of California DWR and the SCVWD study mentioned earlier, to determine the technical, agricultural, and economic feasibility of the reclamation and reuse of a portion of the SBDA wastewater for agricultural irrigation in south Santa Clara County and the Bolsa area of San Benito County. The objectives of the analysis are to:

- Estimate the actual cost of facilities required for treatment and transport of a total of 50,000 acre-feet per year of reclaimed wastewater to agricultural areas in either south Santa Clara County or north San Benito County
- Estimate the cost of this water to the farmer as compared to a San Felipe water supply, including identification of potential price subsidies and other incentives
- Analyze the environmental impacts of the use of this reclaimed water in the region, with emphasis on the impacts on the agricultural environment

This section is based on existing data sources. No pilot study or other independent field surveys (such as baseline data gathering) were performed.

The planning of treatment and transport systems is conceptual in nature, using the systems dictated by State of California Administrative Code (Title 22, Division 4, Environmental Health, 1975 -- see Appendix L) and the transport system designed by California DWR (1977). While a number of technically feasible treatment/transport systems could have been considered, it was decided to limit the number of conceptual plans for ease in economic and agricultural analysis. These systems provide a broad overview of possible reclamation/reuse programs. Should such a program be selected for further study, more detailed designs and analyses could be based on this conceptual overview.

While this analysis focuses on the uses of reclaimed water for agriculture in Santa Clara and San Benito Counties, other potential uses (i.e., open space irrigation, landscaping, industrial cooling) do not conflict with use of 50,000 acre-feet of reclaimed water for agricultural irrigation (see also Section IV.2.5). In addition, if such an irrigation project is incorporated into a wastewater management plan for the counties, it is possible that the distribution and treatment systems could be designed for eventual changeover to landscape or industrial uses, should the agricultural market be reduced or eliminated.

In the remaining parts of this section, discussions of conceptual design and transport systems, agricultural impacts of using treated wastewater, and economic assessment of agriculturally acceptable systems will be presented in detail, along with a brief analysis of other types of impacts that might result from implementation of reclamation and agricultural reuse. In summary:

- It is possible to produce an irrigation water of good quality by a number of treatment schemes, including blending with potable water from another source.

- Additional wastewater treatment would be necessary. Costs of this additional treatment, depending on the treatment scheme selected (see Section V.3.2), are substantial and would cost between $150 and $570 per acre-foot. After federal and state subsidies and grants, this would be an increase of the cost of water to the farmer of between $9 and $56 per acre-foot if sold through the Santa Clara Valley Water District.

- This irrigation water would cause few or no problems on well-drained soils with proper management, but some losses in production might occur to salt sensitive crops.

- Installation of tile drainage may be necessary in much of the Bolsa area of San Benito County, along with an unknown amount of land reclamation due to saline soil conditions, before any irrigation water, regardless of quality, would produce benefits to the farmer.

V.2

STUDY AREA

The study area consists of agricultural lands in south Santa Clara County and north San Benito County, which could potentially accept approximately 50,000 acre-feet of reclaimed water, or about 12 percent of the combined average 1995 SBDA effluent. (The Department of Water Resources (1976) selected the figure of 50,000 acre-feet/year as appropriate for an annual agricultural reclaimed water demand, based on their knowledge of the south Santa Clara Valley.) Aspects of the environment pertinent to reclamation are presented in this section, with an emphasis on agricultural use, water demand, and water and soil quality. Since this survey deals only with conceptual design of reclamation facilities, project sites and routings are not identified in detail, and detailed baseline descriptions are not included. However, data surveys are recommended if a reclamation project is to be implemented in the study area.

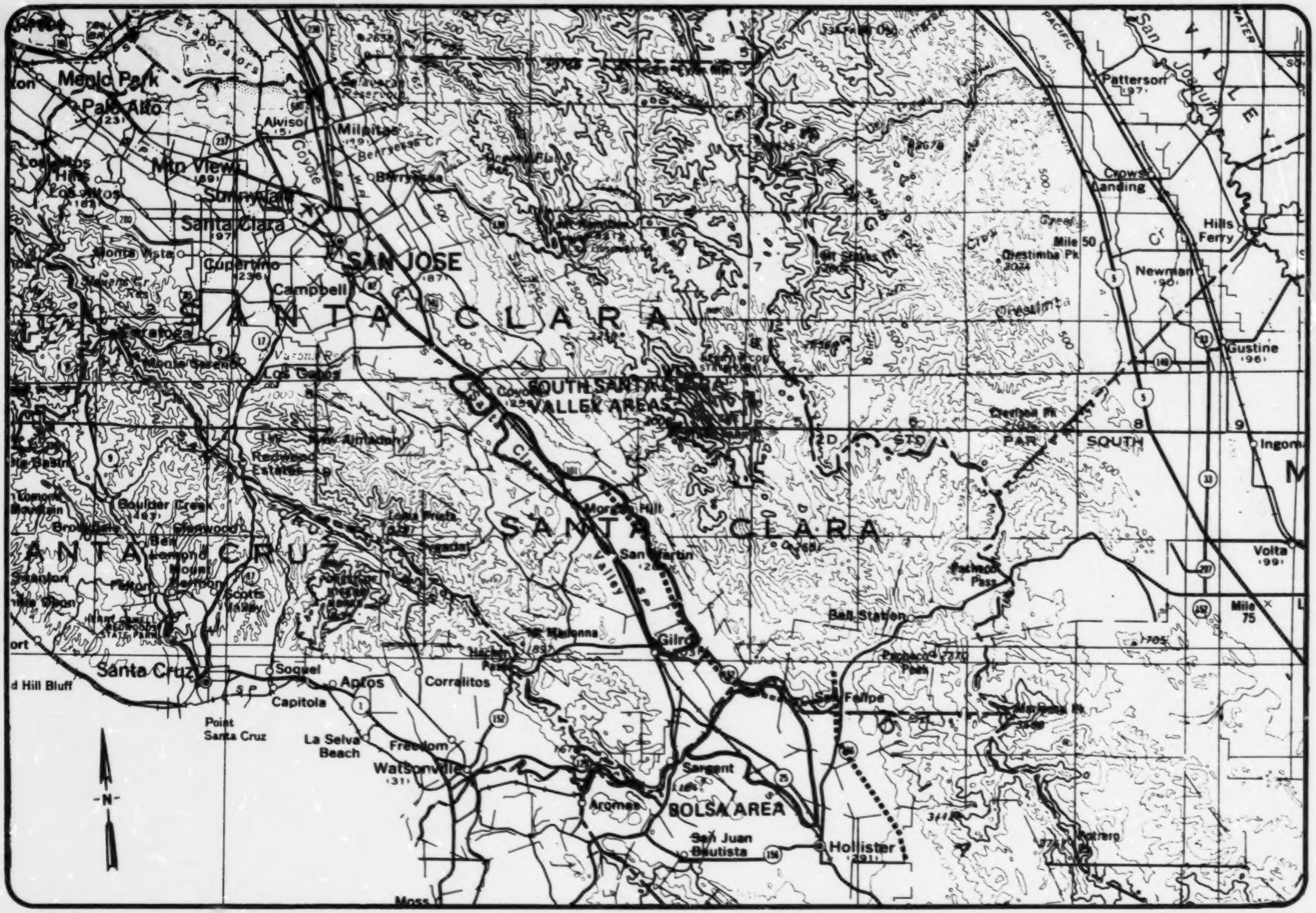
V.2.1 LOCATION OF STUDY AREA

The study area, shown in Figure V-1, consists of the agricultural land in south Santa Clara County from San Jose south to Gilroy and the Bolsa area of north San Benito County. The Santa Clara County portion of the study area lies in the Santa Clara Valley, a narrow flat valley with approximately 27,000 acres of irrigated lands (personal communication, U.C. Agricultural Extension Service, Santa Clara County, 1977) within the South Santa Clara Subarea of the San Felipe Project service area (California DWR, 1976, and USBR, 1976b). The Bolsa area of San Benito County (Figure V-2) is a flat area of approximately 20,000 acres of arable land sloping toward the Pajaro River in the west. This area is within the boundaries of Hollister Subarea of the San Felipe Project service area (USBR, 1976b). The Bolsa area was deleted from the Hollister Subarea when the land class was updated with the assumption that it would be served by groundwater (USBR, 1973).

V.2.2 WATER DEMAND AND SUPPLY

In the Santa Clara County portion of the study area, approximately 63,000 acre-feet of water are required for irrigation in a normal rainfall year. A breakdown of water requirements by crop for the Santa Clara County portion of the study area is shown in Table V-1. This water is obtained from the groundwater reservoir, which is naturally recharged by runoff from the surrounding hills. In addition, artificial recharge for purposes of stabilizing the water table is practiced by the Santa Clara Valley Water District, using local and imported water (see also Section II.3.2).

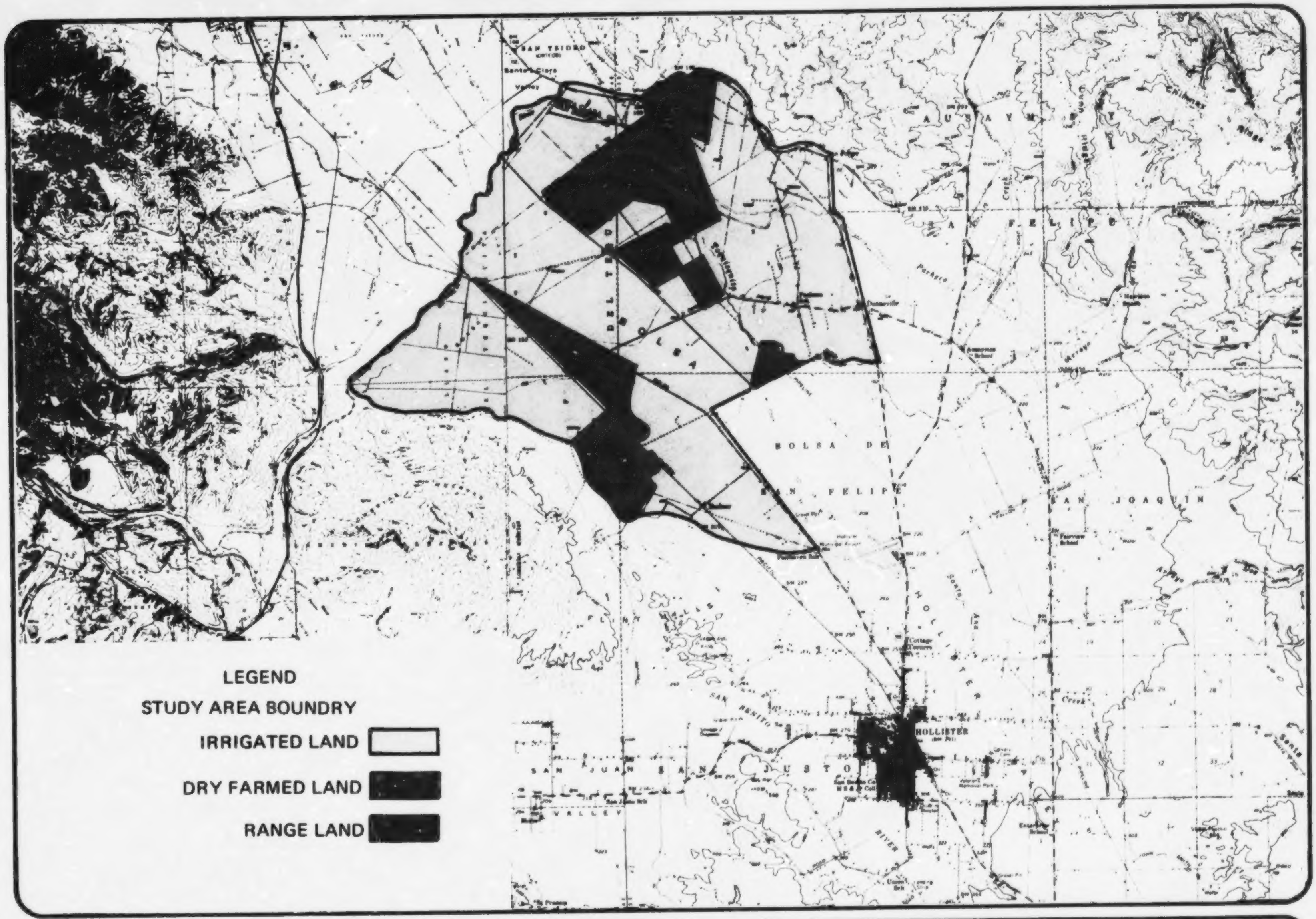
In northern San Benito County, groundwater is the major water supply, while additional sources to the area will come from the San Felipe Project. The South Santa Clara Valley Water Conservation District also practices groundwater recharge, but presently groundwater in the area is in short supply (RWQCB-3, 1975) with water withdrawal


Menlo Park
Palo Alto
Mtn View
Sunnyvale
Santa Clara
Cupertino
Campbell
SAN JOSE
Milpitas
Alviso
Berryessa
Los Altos
Saratoga
Los Gatos
SANTA CLARA
SOUTH SANTA CLARA VALLEY AREAS
Morgan Hill
San Martin
Gilroy
SANTA CLARA
SANTA CRUZ
Boulder Creek
Ben Lomond
Felton
Scotts Valley
Santa Cruz
Soquel
Capitola
Aptos
Corralitos
Point Santa Cruz
La Selva Beach
Freedom
Watsonville
Aromas
Sargent
BOLSA AREA
San Juan Bautista
Hollister
San Felipe
Pacheco Pass
Bell Station
Patterson
Crows Landing
Newman
Hills Ferry
Gustine
Ingomar
Volta
Mile 50
Mile 75
Moss

SOURCE: U.S.B.R., 1975

•••••••••••••••••••••••••• **APPROX. LOCATION OF SAN FELIPE PROJECT CONDUITS**

Figure V-1
LOCATION OF RECLAMATION RE-USE STUDY AREA


LEGEND
STUDY AREA BOUNDRY
IRRIGATED LAND
DRY FARMED LAND
RANGE LAND
SAN YSIDRO
AUSAYMAS Y SAN FELIPE
BOLSA
BOLSA DE SAN FELIPE
SAN JOAQUIN
HOLLISTER
SAN JUAN SAN JUSTO
SAN BENITO RIVER
VALLEY

SORUCE: U.S.D.A. 1969

Figure V-2
PORTIONS OF THE BOLSA CONSIDERED AS A MARKET FOR RECLAIMED WATER

exceeding recharge and no further development potential available (California DWR, 1975a). The Bolsa area is not scheduled to receive San Felipe Project water, and poor drainage, perched water tables, and saline soils restrict present agricultural demands on the groundwater supply. There are no data presently available on the agricultural consumption of water on the 13,500 acres of irrigated land in the Bolsa area (Table V-2).

V.2.3 QUALITY OF GROUNDWATER SUPPLIES

Groundwater quality in the Santa Clara County portion of the study area is excellent for irrigation, and present recharge policies ensure a continued supply of good quality water for all uses. In San Benito County, however, the groundwater is highly variable, affected by the geological characteristics of the area (Table V-3). Saline water and toxic concentrations of boron make the water of several areas unsuitable for irrigation use.

V.2.4 QUALITY OF SOILS

In the Santa Clara County portion of the study area, the soils belong to the Yolo-Zamora-Brentwood soils association. These consist of clayey loams, which are well-drained with moderate permeability (SWRCB and RWQCB, 1974). In general, clays dominate in the low-lying areas, while loam and gravelly loam are found in upper portions of the valleys (Environmental Science Associates, 1974) and are rated as prime or moderately good soils for cropland.

In the Bolsa area, soils belong to the Clear Lake-Pacheco-Willows soils association (U.S. Department of Agriculture Soil Conservation Service, 1969). These are fine-textured, nearly level, poorly drained soils that formed in alluvium derived from sedimentary rocks. The natural vegetation in areas not cultivated consists of grasses, forbs,* and salt tolerant plants.

Salinity is a problem in most soils of the Bolsa. A systematic survey of these conditions has not yet been performed for the area. However, at several locations, highly saline soils (ECe = over 25,000 micromhos per cm) are known to be present. These conditions result

Table V-1

IRRIGATION WATER REQUIREMENTS FOR CROPS
IN SANTA CLARA COUNTY STUDY AREA
(Personal communication,
U.C. Agricultural Extension Service,
Santa Clara County, 1977)

Crop	Crop Acreage	Water Applied (acre-feet/acre per year)[1]	Total Water Requirement (acre-feet/year)
Orchards			
Apricots	2,419	2.0	4,838
Cherries	721	2.0	1,442
Grapes	1,834	2.0	3,668
Pears	1,474	2.0	2,948
Prunes	7,342	2.0	14,684
Walnuts	3,104	2.5	7,760
Misc. Orchards	390	2.0	780
Subtotal	17,284		36,120
Vegetables			
Anise	10	2.0	20
Beans, Snap	335	2.0	670
Broccoli	50	2.0	100
Cabbage	70	2.5	175
Cauliflower	55	2.0	110
Chinese Vegetables	660	3.0	1,980
Corn	240	2.5	600
Cucumber	440	2.5	1,100
Endive	40	2.0	80
Garlic	500	1.5	750
Lettuce, Head	425	5.0[2]	2,125
Lettuce, Leaf	390	5.0[2]	1,950
Lettuce, Romaine	90	5.0[2]	450
Mustard	50	1.0	50
Onions	305	2.0	610
Peppers, Bell	360	3.0	1,080
Peppers, Chili	315	3.0	945
Spinach	80	3.0	240
Squash	105	2.0	110
Tomatoes, Fresh	85	2.5	212
Tomatoes, Processed	2,500	2.5	6,250
Tomatoes, Cherry	70	2.5	175
Misc. Vegetables	700	2.5	1,750
Subtotal	7,875		21,532
Field			
Alfalfa	230	3.0	690
Pasture	700	3.5	2,450
Sugar Beets	2,120	2.3	2,576
Subtotal	2,050		5,716
Grand Total	27,209		63,368

Notes:
(1) Typical rates of application.
(2) Double cropped.

from poor drainage of the soils and from the use of saline irrigation water. Electrical conductivity of monitored well waters ranges from 750 to 2,250 micromhos per cm.

Table V-2

IRRIGATED ACREAGES BY CROP IN BOLSA STUDY AREA

Crop	Acreage Irrigated(1)
Tomatoes	4,500
Sugar Beets	1,400
Alfalfa and Irrigated Pasture	1,700
Miscellaneous Vegetables	2,000
Orchards	900
Grain and Hay	3,000
Total	13,500

Note:
(1) Estimated from visual survey of area, May 1977

The Clear Lake soils consist of poorly drained, very dark gray clays underlain by dark gray clay over gray clay. These soils are in basins. The Pacheco soils are on floodplains and are poorly drained. They have a dark gray silt loam surface layer and a grayish-brown clay loam subsoil. The Willows soils occur in basins and are poorly drained and saline-alkali. They have a grayish brown clay surface layer underlain by light yellowish brown clay.

In addition to the above three soils, the Metz, Rincon, and Cropley soils also occur in smaller areas in the Bolsa. Soils of this association are intensively cultivated with row and field crops, alfalfa, and small grains. Fruits and nuts are grown in areas that have been drained. Drainage is needed in most areas, and reclamation is needed in alkaline areas and areas affected by salts before intensive irrigated agriculture can be profitable.

Table V-3

GROUNDWATER QUALITY IN STUDY AREA
(California DWR, 1975b)

Parameter Sampled	Typical Range in Values from Wells in Basin	
	Santa Clara Valley(1)	Bolsa(2)
pH	8.1-7.3	8.3-7.6
Electrical Conductance, (micromhos/cm)	1,200-409	5,460-235
Calcium (mg/1)	100-32	260-8.8
Magnesium (mg/1)	78-19	243-5.8
Sodium (mg/1)	56-16	535-26
Potassium (mg/1)	1.1-0.1	9-0.9
Carbonate (mg/1)	0	0
Bicarbonate (mg/1)	794-166	563-56
Sulfate (mg/1)	41-2.8	311-3.8
Chloride (mg/1)	27-10	1,620-27
Nitrate (mg/1)	61-0	205-2.7
Boron (mg/1)	0.1-0	0.4-0
Fluoride (mg/1)	-	-
TDS (mg/1)(3)	546-238	3,620-174
Total Hardness (mg/1)	407-177	1,650-46
Sodium Absorption Ratio	1.3-0.5	5.7-1.1

Notes:
(1) Gilroy-Hollister area. See also Table II-28 for north county.
(2) Pajaro Valley area.
(3) Total dissolved solids by gravimetric determination.

For detailed information on the distribution of various water quality levels throughout the Santa Clara Valley, see U.S. Bureau of Reclamation, 1976, and Bechtel Inc., 1974.

---

* Forbs are herbaceous plants other than grasses.

The effect of saline soil conditions or a water supply with a high salt level is a decrease in plant growth and productivity. As salinity increases, productivity decreases until lethal salt levels are reached and plants are killed. Symptoms of saline conditions can be seen scattered over most of the area. Fields lying lower than the surrounding area are not cultivated, but are covered with grasses and other salt tolerant plants. In some barley fields, large barren spots indicate where seed failed to germinate because of saline conditions. Some spots are covered with white salt crystals where capillary action has brought the salts to the surface. About 4,000 acres of land are not used to full potential due to salty conditions and lack of water.

V.2.5 AGRICULTURAL LAND USE

As described in Section V.2.1, the study area consists of approximately 27,000 acres in Santa Clara County and 20,000 acres in the Bolsa area of San Benito County. The 27,000 acres in Santa Clara County are in irrigated crops (Table V-1), while only 13,500 acres in the Bolsa are presently irrigated (Table V-2). An additional 2,000 acres in the Bolsa are dry farmed and 2,000 acres are in rangeland. An additional 4,000 acres are not used because of salty soils and the lack of a suitable water supply. Crop production data for the two areas are shown in Tables V-4 and V-5.

Thirty years ago, the dominant land use in Santa Clara County was agricultural (Section II.2.1), but urbanization has resulted in a displacement of agriculture in the north county area (Daniel, Mann, Johnson, and Mendenhall, et al., 1977). Depending on regional and county policies for sewer, water, transportation, and zoning, this type of decrease in agricultural land use may also occur in the study area in future years. This urbanization pressure, coupled with the fact that agriculture in the Santa Clara Valley is rapidly becoming less competitive with the large-scale efforts in California's Central and Imperial Valleys (Santa Clara County Agricultural Extension, personal communication, May 1977), may result in a decrease in agricultural lands and a switch from less productive crops to specialty crops on the remaining agriculturally productive land. Present suggestions for the establishment of an agricultural preserve of between 10,000 and 20,000 acres may reduce urbanization pressures in the preserve area, but other measures would have to be employed to ensure continued competitive agriculture. No action on the preserve concept has been taken at the time of publishing this EIR/EIS. However, these methods may include subsidized high quality water supplies, restrictive zoning, adjusted tax schedules giving preference to agricultural use, county-sponsored markets for specialty crops, and other subsidies (Santa Clara County Board of Supervisors and Santa Clara County Agricultural Extension, personal communication, May 1977).

In all of the Central Coastal Region, irrigated acreage is expected to increase whether or not reclamation is implemented by the year 2000. The acreage increase will be constrained only by availability and quality of the water supply (RWQCB-3, 1975). Approximately 20,000 of the acres suitable for irrigation are in the Pajaro subregion, which contains the Bolsa study area. This subregion is also expected to sustain a ten-fold increase in urban acreage, some of which may occur in lands now classified as suitable for irrigation.

Table V-4

CROP PRODUCTION DATA FOR SANTA CLARA COUNTY
(County of Santa Clara, Department of Agriculture, 1976)

Crops	Acreage			Production			
	County Total	North of Gilroy[1]	South of Gilroy	Yield (ton/acre)	Unit Price ($/ton)	Gross Income ($/acre)	Gross Income ($1,000)
Orchards							
Apricots	2,819	2,419	400	4.86	300	1,458	4,110
Cherries	1,021	721	300	2.92	610	1,781	1,818
Grapes	2,334	1,834	500	3.33	205	682	1,593
Pears	1,774	1,474	300	7.16	129	923	1,638
Prunes	8,362	7,362	1,000	1.39	385	535	4,474
Walnuts	3,706	3,106	600	0.65	470	304	1,128
Miscellaneous Orchard	390	390	–	–	–	1,538	600
Total	20,384	17,284	3,100				15,353
Vegetables							
Anise	10	10	–	8.75	180	1,575	16
Beans, snap	335	335	–	4.57	370	1,690	566
Broccoli	50	50	–	2.60	280	728	36
Cabbage	70	70	–	9.2	80	736	51
Cauliflower	55	55	–	4.0	240	960	53
Chinese Vegetables	660	660	–	18.0	100	1,800	1,188
Corn	240	240	–	5.58	160	893	214
Cucumber	1,240	440	800	14.0	120	1,680	2,083
Endive	60	60	–	9.0	120	1,080	65
Garlic	500	500	–	5.2	382	1,986	993
Lettuce, Head	625	425	200	10.7	116	1,241	776
Lettuce, Leaf	390	390	–	5.79	173	1,002	391
Lettuce, Romaine	90	90	–	15.9	66	1,049	94
Mustard	50	50	–	4.3	240	1,032	52
Onions	505	305	200	22.6	200	4,520	2,280
Peppers, Bell	860	360	500	9.5	152	1,444	1,242
Peppers, Chili	315	315	–	6.51	370	2,409	759
Spinach	80	80	–	5.6	300	1,680	134
Squash	105	105	–	7.8	162	1,263	133
Tomatoes, Fresh	85	85	–	19.1	230	4,393	373
Tomatoes, Processed	8,500	2,500	6,000	24.9	55	1,369	11,640
Tomatoes, Cherry	70	70	–	22.6	340	7,684	537
Miscellaneous Vegetables	700	700	–	–	–	1,143	800
Total	15,575	7,875	7,700				24,480
Field							
Alfalfa	230	230		5.2	60	312	72
Pastures	1,500	700	800	–	–	150	225
Sugar Beets	2,120	1,120	1,000	31.0	28	868	1,840
Total	3,850	2,050	1,800				2,137
Grand Total	39,809	27,209	12,600				41,970

Note:
(1) From Table V-1.

Table V-5

CROP PRODUCTION DATA FOR THE BOLSA AREA OF SAN BENITO COUNTY
(Agricultural Commission, San Benito County, 1975)

Land Use	Acres(1)	Yield (ton/acre)	Unit Price ($/ton)	Gross Income ($/acre)	Total Gross Income ($1,000)
Irrigated					
Tomatoes	4,500	25	56	1,400	6,300
Sugar Beets	1,400	29.3	29.5	865	1,210
Alfalfa and Irrigated Pasture	1,700	7.6	75	513	969
Vegetables	2,000	10.25	160	1,684	3,280
Orchard	900	1.2	500	600	540
Grain and Hay	3,000	1.25	70	87	262
Subtotal	13,500			930	12,561
Dry Farmed	2,000	1	55	110	110
Range	2,000	4	25	10	20
Total	17,500			725	12,691

Note:
(1) From Table V-2. See Figure V-12 of the Bolsa area.

V.3

CONCEPTUAL DESIGN

The South Bay Dischargers Authority (SBDA) is responsible for disposing of wastewaters that flow through the Palo Alto (PA), the Sunnyvale (SV), and San Jose/Santa Clara (SJ/SC) water pollution control plants (WPCP). Previous studies (Bechtel, 1974, and Section IV.2.5) have indicated that wastewater reclamation is not a viable means of disposing of all of the SBDA wastewater, and that cost-effective and environmentally acceptable disposal would involve the discharge of SBDA effluent to San Francisco Bay.

A significant amount of work has already been done in the development of SBDA wastewater reclamation system concepts, designs, and costs (California DWR, 1976; Consoer-Bechtel, 1974a and 1974b; Bechtel 1974), with an emphasis on markets for reclaimed water and alternative conveyance and distribution systems. This section incorporates this previous work into a discussion of:

- The potential markets for reclaimed water, and the quantities of water available to meet the demands
- The quality of the available wastewater, the water quality required for irrigation, and the treatment necessary to meet quality requirements
- The design of conveyance and distribution pipeline and pumping systems required to move the water from the source to the user
- The design of treatment facilities required to produce acceptable irrigation water quality
- Estimates of the capital and operating costs of conveyance, distribution, and treatment facilities
- The potential effectiveness of source control as a means of improving reclaimed water quality.

- The potential viability of various schemes for blending reclaimed water with water from other supplies to produce acceptable water quality

This section does not address reclamation of wastewater for any purpose other than agricultural irrigation. Other potential markets or demands for reclaimed water, such as ornamental green space irrigation (parks, golf courses), industrial reuse, groundwater recharge, salt water intrusion control, and others, have been investigated in other studies. In general, it has been determined (Section IV.2.5) that the quantities of reclaimed water that would be absorbed by these usages are minimal when compared to the quantity of SBDA effluent available.

V.3.1 POTENTIAL MARKETS

The study area can be divided into four regions with respect to irrigation demand for reclaimed wastewater (Figure V-1): north Santa Clara Valley, south Santa Clara Valley, San Benito County south and east of Hollister, and the Bolsa in San Benito County north of Hollister.

North Santa Clara Valley is highly urbanized and is the source of most of the wastewater considered for reclamation in this study. The future market for agricultural irrigation water in this area is negligible, because the present rate of urban enroachment on croplands will deplete all North Valley land by 2020 (California DWR, 1976).

In contrast, south Santa Clara Valley is expected to remain primarily agricultural according to Santa Clara Valley Water District projections (California DWR, 1976). Thus, all of the increase in agricultural water demand projected by the Santa Clara Valley Water District (50,000 acre-feet/year between 1975 and 2020, as reported California DWR, 1976) can be assumed to occur in this area.

The Hollister subarea (that portion of San Benito County south and east of Hollister in the San Felipe Service Area) consists of 64,859 acres, at which 40,793 are arable (U.S. Bureau of Reclamation, 1973). Of these arable lands, 97 percent are irrigable, but only 94 percent are classified as productive. Presently, 60 percent of the irrigable productive lands During the design period it was projected that the San Jose/Santa Clara water pollution control plant will produce between 119 mgd and 143 mgd of effluent (Consoer-Bechtel, 1974a and 1974b) with an average of 131 mgd. The wastewater reclamation system will absorb up to 103 mgd of this, leaving a residual varying between 16 and 143 mgd to be disposed of by SBDA. While some higher estimates of the SJ/SC flow rate have been made, it is appropriate to use a conservatively low number for this study. It should be noted that the design flow capacity of the SJ/SC advanced wastewater treatment facility (AWTF) now under construction is 143 mgd (Table I-3). The construction and operation of the reclamation system will have no effect on the size or location of the SBDA wastewater disposal system to the Bay, because the SBDA disposal system would still have to accommodate the combined flows of the three treatment plants during seasons of low irrigation water demand. However, the reclamation system may result in some savings in pumping expenses for disposal. For the purposes of this design, it is assumed that the SJ/SC WPCP provides an average flow of 131 mgd and a peak flow of 143 mgd.

Wastewaters from the Palo Alto and the Sunnyvale Treatment plants were considered for reclamation, in addition to the SJ/SC flow. It was found that the irrigation demand could be met using only the SF/SC effluent, so the cost of interconnecting the other two smaller plants was not considered in this study.

The cities of Morgan Hill and Gilroy are located near the center of the projected market area for this reclamation project, so it is reasonable that wastewaters from these cities could be reclaimed more economically than the SJ/SC wastewaters. The municipal wastewaters from these cities are collected and treated at a plant in southeast Gilroy. The projected flow is 5 mgd (1985) (Consoer-Bechtel, 1976). Current plans call for primary and secondary biological treatment, followed by disposal in percolation ponds. Some 15 mgd of industrial wastewater also will be disposed of in nearby percolation ponds in 1985 (Consoer-Bechtel, 1974a and 1974b). Some of the industrial wastewater is currently combined with the groundwater and used in agriculture.

The reclamation of the Gilroy municipal and industrial wastewaters will require additional treatment, as discussed in a previous report (Consoer-Bechtel, 1974a and 1974b). While the design of such treatment and any required conveyance and distribution facilities for Gilroy wastes is outside the scope of this report, reclamation of Gilroy wastewater will affect the market for SBDA wastewater. However, considering the level of accuracy of the preliminary 50,000 acre-feet/year demand and 103 mgd peak flow estimates, the possible increase or decrease in market due to reclamation at Gilroy can be neglected. More significantly, reclamation at Gilroy would tend to accentuate the seasonal nature of the demand for SJ/SC wastewater. Low winter demands could be met from Gilroy alone, leaving SBDA to discharge its whole waste load to the Bay, while Gilroy's contribution toward meeting summer demand would be small. Since the costs of reclamation at SJ/SC are dependent mainly on the magnitude of peak flows, the possibility of reclamation at Gilroy should not affect the results of this report and is not considered further.

The SBDA water reclamation system, if selected as a part of this project, would be designed to supply a 50,000 acre-feet/year (44.6 mgd average flow) market in either the SSCV or the Bolsa. The reclamation facilities will be designed for a 103 mgd peak monthly flow. This flow will be diverted as needed from the SJ/SC WPCF effluent flow, which ranges between 119 mgd and 143 mgd during the design period, with an average of 131 mgd.

V.3.2 RECLAIMED WATER QUALITY

The quality of the water reclaimed from the SJ/SC WPCP effluent is determined by a number of factors, including the quality of the existing effluent and the effects of source control, changes in water usage patterns, level of reclaimed water treatment, and possible blending with water from other sources. The feasibility of any proposed reclamation will depend on whether or not the water is acceptable for irrigation. Requirements are irrigated with groundwater, but the lack of groundwater supplies and the high boron or salt concentrations in some groundwater supplies have limited development. The Bureau of Reclamation (1973) indicates that proper monitoring of water tables and installation of drainage could allow more productive use of the remaining acreage. However, the portion of San Benito County south and east of Hollister is the most difficult to supply with reclaimed water from SBDA due to the distance involved. In addition, the farmers in south San Benito County area have contracted to be supplied by the San Felipe Diversion, and projected demand in the area will likely be met by this new source.

The area north of Hollister in San Benito County called the Bolsa is not included in the projected San Felipe Project service area, since it was assumed to be served by available groundwater supplies (U.S. Bureau of Reclamation, 1973). Much of the arable land in the Bolsa is not cultivated due to the lack of suitable soil conditions, the lack of drainage, and the poor quality of the groundwater. If drainage is installed in the Bolsa, reclaimed wastewater could be applied to irrigate approximately 20,000 acres, including the 13,500 acres now irrigated. Assuming a typical annual irrigation of 2.5 acre-feet per acre (average application based on figures shown in Table V-1), the projected market in the Bolsa area is 50,000 acre-feet/year, or 44.6 mgd.

The Department of Water Resources (1976) selected a figure of 50,000 acre-feet/year as an appropriate annual reclaimed water demand to be used for conceptual planning purposes, based on the market in the south Santa Clara Valley. There is a distinct possibility that this demand may not materialize due to urbanization. (This is contrary to Santa Clara Water District projections.) On the other hand, the projected 50,000 acre-feet/year demand in the Bolsa will develop only if drainage is installed and provision is made for disposal of drainwater. Since it would take about 16 years for planning, design, and construction, the earliest date of water delivery to consumers would be about 1991 (California DWR, 1977). Therefore, for purposes of this study, two alternative market projections were made for a design period from 1990 to 2020. The markets considered were either a 50,000 acre-feet/year market in the south Santa Clara Valley, or a 50,000 acre-feet/year market in the Bolsa. Two conveyance and distribution system design alternatives were proposed for these markets. The monthly distribution of yearly water demand in the Santa Clara Valley has been estimated by the DWR on the basis of agricultural pumping power usage records and is listed in Table V-6.

Table V-6

YEARLY DEMAND FOR WATER IN SANTA CLARA COUNTY
(California DWR, 1976)

Month	Percent of Yearly Demand	Flow (mgd)
October	12	64
November	5	27
December	1	5
January	0	0
February	1	5
March	2	11
April	3	16
May	10	54
June	19	103
July	18	96
August	13	70
September	16	86

Note: Mean annual flow = 44.6 mgd = 50,000 acre-feet/year.

While irrigation demands are seasonal, it has been shown to be cost-inffective to store winter wastewater flows for use in summer (California DWR, 1976). The reclamation systems in this study are designed to provide a flow peaking in June and dropping to zero in January.

for irrigation waters are discussed in Section V.4.1. A summary of the applicable water quality standards is provided in Table V-7. In addition to the requirements listed in Table V-7, irrigation water criteria have been suggested for individual heavy metals and trace elements. However, these standards have negligible impact on this conceptual study due to lack of complete data on these trace materials in existing waters. The data that are available indicate that trace elements and heavy metal standards will probably be met by all alternatives under study.

Table V-7

WATER QUALITY CRITERIA
FOR IRRIGATION WATERS(1)
(FWPCA, 1968)

Parameter	Approximate Values for Acceptable Irrigation Water
Conductivity (µmho/cm)	750
Sodium Absorption Ratio, adj.	6
pH (minimum and maximum)	6.5 – 8.0
Sodium (mg/l)	70 mg/l (3 meq/l)(2)
Chloride (mg/l)	140 mg/l (4 meq/l)
Boron (mg/l)	0.75
Bicarbonate (mg/l)	90 (1.5 meq/l)(2)
Nitrate Nitrogen(3) (mg/l)	10(4)

Notes:
(1) It is important to note that waters of higher values than shown in this table are often entirely usable under good water management and for selected crops.
(2) Only applicable for overhead sprinkling.
(3) Ammonia nitrogen can contribute to this.
(4) This level, 10 mg/l, of nitrate nitrogen could affect some sensitive crops.

An estimated characterization of the projected effluent from the SJ/SC WPCP is presented in Table V-8. This characterization is based on data for the existing SJ/SC effluent, adjusted to take into account changes in effluent quality expected to occur in the advanced waste treatment facilities now under construction. The changes include reductions in BOD$_5$, TDS, NH_3-N, and bicarbonate, along with an increase in NO_3-N projected to occur due to the nitrification and filtration processes in the advanced wastewater treatment. While lower levels of some parameters (e.g., TDS) may occur on a seasonal basis, the data presented allow conceptual design of treatment schemes to be adjusted to the "worst" case, thereby ensuring a more reliable water quality for reuse.

Table V-8

CHARACTERIZATION OF PROJECTED EFFLUENT FROM THE SAN JOSE/SANTA CLARA WATER POLLUTION CONTROL AND ADVANCED WASTEWATER TREATMENT FACILITY
(Developed from Design Data, Provided by Consoer, Townsend and Associates, 1974, and Presented in Bechtel, 1974)

Parameter	Normal Value	Parameter	Normal Value
BOD$_5$	10	Aluminum (mg/l)	5.0
TSS	10	Arsenic (mg/l)	0.001
Turbidity (TU)	10	Beryllium (mg/l)	ND(1)
Coliforms (no./100 ml)	2.2	Cadmium (mg/l)	0.001
pH (pH units)	7.5	Cobalt (mg/l)	ND
Conductivity (µmho/cm)	1,400	Chromium (mg/l)	0.02
Phosphate as phosphorous (mg/l)	10	Copper (mg/l)	0.05
Silica (mg/l)	30	Fluoride (mg/l)	0.8
Ammonia as nitrogen (mg/l)	2	Iron (mg/l)	0.25
Nitrate as nitrogen (mg/l)	20	Lithium (mg/l)	ND
Potassium (mg/l)	14	Lead (mg/l)	0.015
Sodium (mg/l)	170	Manganese (mg/l)	0.15
Calcium (mg/l)	60	Molybdenum (mg/l)	0.4
Magnesium (mg/l)	12	Nickel (mg/l)	0.03
Chloride (mg/l)	200	Selenium (mg/l)	ND
Sulfate (mg/l)	120	Strontium (mg/l)	ND
Bicarbonate (mg/l)	250	Vanadium (mg/l)	ND
Carbon Dioxide (mg/l)	10	Zinc (mg/l)	0.1
		Boron (mg/l)	0.75
		Sodium Absorption Ratio (adj.)(2)	10.5
		TDS (mg/l)	850

Notes: (1) ND = no data.
(2) See Section V.3 for explanation of adj. SAR.

Source Control

As can seen by comparing Tables V-7 and V-8, it would be desirable to reduce conductivity, sodium, SAR, and chloride in the SJ/SC WPCP effluent. One method of reducing such components is source control, i.e., preventing the discharge of the materials to the sewer system. Conductivity can be reduced by reducing sodium and chloride, which are in themselves a problem in irrigation. Thus, effective source control should focus on NaCl in the SJ/SC sewage.

There are four identified sources for NaCl in the SJ/SC effluent. Some 90 mg/l is present in the water supply to the service area (Consoer-Bechtel, 1975a and 1974b) and cannot be removed without changing the water supply. It is estimated that about 180 mg/l is added due to normal domestic water usage/sewage production processes, and this source cannot be controlled. The third source of NaCl in SJ/SC sewage is seawater intrusion into sewage pipes, particularly in the Alviso area. This source is responsible for about 25 mg/l of NaCl in the effluent, since the flow from Alviso is small. The fourth source of NaCl is the salt used to regenerate home water softeners in the service area. It is estimated that such spent ion exchange regenerant contributes about 100 mg/l of NaCl to the SJ/SC WPCP effluent. It is possible at least partially to eliminate this salt from the sewage through legislation banning the use of home water softeners. This action would incur significant costs to the residents in the service area who would be required to abandon their home recharged water softeners and use water service recharged tanks. An additional cost would be the administrative and enforcement costs to municipalities in the service area.

An alternative means of controlling this NaCl is to construct and operate public water softening plants for the groundwater utilized by the Santa Clara Water District, while simultaneously banning individual wells and home recharged water softeners. However, this control strategy is expensive and for the purposes of this study is assumed to be unlikely.

The wastewater characterization in Table V-8 shows the sodium and chloride levels predicted after elimination of seawater infiltration and inflow in the Alviso system, with no reduction in home water softener spent regenerant discharge. The characterization does not take into account the rise in NaCl content and waste TDS that could occur if continued shortage of water supply results in increased domestic recycle (e.g., grey water systems) or other water conservation measures. More intensive use of water generally results in a more concentrated sewage of lower volume. Since the effects of a ban on water softeners would tend to cancel the effects of an increase in water conservation on NaCl concentrations, the characterization in Table V-8 is assumed to be valid even if source control and water conservation measures were implemented.

Level of Reclaimed Water Treatment

The above discussion outlined the impact on reclaimed water quality of source control, changes in water usage patterns, and the present water quality. The impact of various alternative blending schemes is discussed in Section V.3.6. The remaining factor in determining reclaimed water quality is the level of treatment provided for the reclaimed water in addition to the wastewater treatment provided by the SJ/SC WPCP and AWTF. Four conceptual alternatives were identified and dealt with in detail in this study. The identified alternatives are intended to cover the range of possible treatments. Other treatment alternatives can in general be dealt with in planning simply by characterizing them as incrementally more or less expensive and effective than one of the identified alternatives.

The four identified alternative treatment systems are as follows:

Case A: No reclaimed water treatment

Case B: Chemical coagulation and sedimentation

Case C: Coagulation, sedimentation, and desalination

Case D: Coagulation, sedimentation, desalination, and activated carbon absorption

Under Case A, the effluent from the San Jose/Santa Clara AWTF now under construction would simply be diverted and distributed as is, for irrigation. The sewage from the SJ/SC service area would be processed through screening, grit removal, primary clarification, secondary activated sludge aeration and clarification, dual-media gravity filtration, and chlorine disinfection. The cost of this treatment would not be attributed to any reclamation project. The projected Case A water quality would be that listed in Table V-8. The projected quality for Case A is also listed in Table V-9 in terms of the parameters of significance in this study.

Under Case B, a minimum of treatment is added to make irrigational reclamation practical. Effluent from biological nitrification is subjected to chemical coagulation and sedimentation prior to filtration and disinfection. The pH is then adjusted downward using sulfuric acid to reduce the sodium absorption ratio (SAR) and to convert unwanted bicarbonate to carbon dioxide, which escapes to the atmosphere. The projected water quality due to Case B treatment is shown in Table V-9.

State of California Department of Health criteria for irrigation water are contained in Title 22, Division 4 of the California Administrative Code. Title 22

Table V-9

PROJECTED WATER QUALITY FOR FOUR TREATMENT LEVELS

Parameter	Treatment Level			
	Case A	Case B	Case C	Case D
TDS (mg/l)	850	Same as A	400	85
Conductivity (μmho/cm)	1,400	Same as A	600	150
pH	7.5	7.0	6.7	6.3
SAR (adj.)	10.45	9.41	4.5	<0.1
Sodium (mg/l)	170	Same as A	80	18
Chloride (mg/l)	200	Same As A	90	20
Calcium (mg/l)	60	Same as A	25	3
Magnesium (mg/l)	12	Same as A	5	0.5
Sulfate (mg/l)	120	200	80	20
Bicarbonate (mg/l)	250	150	70	20
Boron (mg/l)	0.75	Same as A	0.5	0.1
NO_3-N (mg/l)	20	Same as A	10	2
PO_4-P (mg/l)	10	5	2	0.5
Coliforms (No./100 ml)	2.2	<2.2	<2.2	<0.2
Turbidity (TU)	10	2	1	0.1
Carbon Dioxide (mg/l)	10	20	20	10
Agricultural Evaluation(1)				
Salinity	IP	IP	NP	IP
Soil Permeability	SP	IP	IP	NP
Toxicity to Sensitive Crops	IP	IP	NP	NP
Miscellaneous	IP	IP	IP	NP

Note:

(1) The agricultural evaluation of each treatment is categorized under the criteria of no problems (NP), increasing problems (IP), and severe problems (SP) if used under average water management and for all crops.

defines two classes of reclaimed wastewater and sets conditions for their lawful use for food crop irrigation. The two classes of wastewater are: (a) waters acceptable for surface irrigation and (b) waters acceptable for spray irrigation. The Case A wastewater fits into the first classification (i.e., surface irrigation) in that it is an "adequately disinfected, oxidized wastewater." Case A wastewater could be legally used for crop irrigation if "contact between the edible portion of any food crop and reclaimed water is prevented," or if the food crops must undergo extensive processing (sufficient to destroy pathogens) prior to human consumption. Since a large portion of the crops grown in the study area are vegetables that do contact the irrigation waters and do not require processing, irrigation with Case A water would necessitate a change in the types of crops grown and reduce agricultural profitability. Case B water, which would qualify for use in spray irrigation, could be used for crops currently grown in the study area.

The administration and inspection procedures required to insure that farmers properly manage their wastewater application using Case A water would be expensive and difficult both legally and politically. Any legally practical reclamation scheme must provide treatment sufficient to meet the criteria for spray irrigation, in which case no legal restrictions are imposed by the Department of Health on the irrigational use of the water and no institutionally difficult, expensive, or unenforceable inspection procedures need be implemented. The spray irrigation criteria requires that the wastewater be oxidized, coagulated with chemicals, and filtered prior to being disinfected (i.e., Case B treatment). The SJ/SC WPCF and AWTF provide for oxidation, filtration, and disinfection, so only chemical coagulation and clarification (sedimentation) need to be added to reduce the turbidity (and TSS) of the wastewater and to increase the efficiency of downstream disinfection. Coagulation can be achieved using lime, alum, organic polyelectrolytes (polymers), ferric salts, or combinations of the above. A combination of alum and a small amount of polymer was selected in this case as being the most economical in view of coagulant chemical costs, pH adjustment costs, and sludge disposal costs. Alum is also the most widely used coagulant for water treatment plant turbidity removal. Besides reducing the turbidity, alum treatment will also reduce the phosphate and bicarbonate concentrations in the wastewater and will increase the sulfate slightly. Thus, the major effect of alum treatment is to enhance a water's aesthetic quality, rather than its chemical quality.

Many of the ionic constituents remaining in the reclaimed water after Case B treatment may have adverse effects on irrigated crops. A number of dissolved inorganic solids removal methods (including ion exchange and electrodialysis) were examined, and the reverse osmosis process was selected as the best means of desalination. Since reverse osmosis is capable of removing about 90 percent of most ions, but since only about 50 percent removal is required to produce an optimal irrigation water, the Case C treatment system makes use of split-flow treatment and blending to meet water quality criteria at the least cost. Coagulation, sedimentation, and pH adjustment (i.e., Case B treatment) would precede the reverse osmosis process in Case C treatment; in Case C treatment, pH adjustment would serve the additional purpose of minimizing carbonate scaling and precipitation in the reverse osmosis unit. The salty reject water resulting from reverse osmosis would be discharged through the conveyance on SBDA disposal after dilution with SBDA effluent. Irrigation with Case C water, whose projected chemical characteristics are shown in Table V-9, should have no adverse effect on crops or soils under good management practices.

While the deep groundwater table in the study area is quite low, and while most applied excess irrigation water will either be carried off in high perched water table areas by drainage facilities or evaporated before it reaches the groundwater table, the possibility exists that some reclaimed water will percolate into the groundwater. Since some groundwater supplies in the study area are used for drinking water, the possibility of indirect potable use (following dilution) also exists. Federal and state regulations (Appendix L) applicable to direct or indirect (e.g., through irrigation) groundwater recharge using reclaimed wastewater are being developed at this time. It is uncertain as to what the ultimate controlling regulations will be. For the purposes of this study, a scenario is put forward in which: (a) reclaimed water irrigation is classified as groundwater recharge, (b) the effects of percolation through the soil is assumed to be negligible, (c) drinking water standards must be met in all irrigation waters, (d) reclaimed water irrigation is legally allowed, (e) treatment (activated carbon adsorption) is required to remove traces of halogenated hydrocarbons and other carcinogenic or toxic organics, and (f) reverse osmosis is effective as a means of removing dissolved inorganic salts, trace heavy metals, and viruses and bacteria that survive disinfection. It should be noted that many of the above-stated assumptions (particularly (c) and (e) would rule out the use of effluents or wastewaters of almost all types, including agricultural point and nonpoint sources, runoffs to surface waters, and many well water supplies.

Case D treatment is proposed as a means of producing reclaimed water of high enough quality to be acceptable for indirect potable reuse (with dilution) through inadvertent groundwater recharge, with no known ill effects on public health. Case D treatment is designed to remove all known harmful pollutants to an acceptable level for drinking water or to the detection level of current analytical technology, regardless of the acceptability of lesser treated waters for agriculture. Case D treatment consists of full flow reverse osmosis downstream of Case B treatment, to be followed by column activated carbon adsorption. A partial characterization of this water is presented in Table V-9.

V.3.3 TREATMENT CONCEPTUAL DESIGNS

This section generates cost estimates for the analysis of alternatives and water reclamation planning in general. The treatment alternatives, A, B, C, and D discussed above (as well as the two conveyance and distribution alternatives discussed below) were broken down into a set of discrete, numbered components. Treatment alternatives were formulated by assembling the proper components, and conveyance and distribution alternatives by assembling other components. Finally, water reclamation schemes were formulated by combining treatment alternatives with appropriate conveyance and distribtuion alternatives. Table V-10 presents a list of the design components. Table V-11 shows how the components are assembled into treatment alternatives.

Table V-10

DESIGN COMPONENTS

No.	Components
1.	Reclaimed water flow diversion
2.	Coagulation and sedimentation treatment
3.	Partial desalination treatment
4.	Carbon adsorption and reverse osmosis treatment
5.	Main pumping station
6.	Conveyance pipeline between pumping stations
7.	Booster pumping station
8.	Conveyance pipeline to the Bolsa area
9.	Bolsa area distribution system
10.	Conveyance pipeline to south Santa Clara Valley
11.	South Santa Clara Valley distribution system

Treatment Case C includes all of the treatment design components except carbon adsorption, and the designs for other alternatives can be described by deleting components from (or adding to) this alternative. Thus, the following description of Case C generally encompasses the other alternatives.

Table V-11

MATRIX OF ALTERNATIVES

Treatment Alternative Case	Conveyance and Distribution Alternatives	Treatment Components Included[1]	Conveyance and Distribution Components[1]
A	Bolsa	1	5,6,7,8,9
A	SSCV	1	5,6,7,10,11
B	Bolsa	1,2	5,6,7,8,9
B	SSCV	1,2	5,6,7,10,11
C	Bolsa	1,2,3	5,6,7,8,9
C	SSCV	1,2,3	5,6,7,10,11
D	Bolsa	1,2,3,4	5,6,7,8,9
D	SSCV	1,2,3,4	5,6,7,10,11

Note:

(1) See Table V-10 for component list.

The effluent from the tertiary nitrification process clarifiers would be diverted to a pumping station and sent through chemical coagulation, flocculation, and sedimentation process units. The water would then be pumped back to pass through the tertiary filters now under construction. The filtered effluent would normally flow to the Bay through the SBDA disposal facilities, but a portion of this flow would be diverted and the alkalinity reduced by addition of sulfuric acid. The diverted flow would be further divided into a blend water stream and a desalination process feed stream.

The product of the desalination process would be mixed with the blend water in the proper proportions to produce the desired reclaimed water quality. The treatment processes are illustrated in the flow diagram in Figure V-3, and on the treatment plant layout in Figure V-4. The designs of the components are described below.

Reclaimed Water Flow Diversion (Component 1)

The reclaimed water diversion structures consist of a large diameter (120 in.) metering valve on a branch out from the filter effluent line, and a conveyance conduit to the inlet of the main reclaimed water pumping station. An open channel design (6 ft wide, 6 ft deep) was selected for the conduit, since the cost is approximately equivalent to that for a closed pipe and since contact with the atmosphere allows the release of dissolved CO_2. Release of CO_2 is important in the adjustment of pH and the reduction of bicarbonate ion concentration, particularly when other treatment components are included in the system.

Coagulation and Sedimentation, with Alkalinity Control (Component 2)

The alum and polymer coagulation and sedimentation process must be placed between the tertiary nitrification process clarifiers and the sand filters. Both of these previously constructed processes are designed for a flow of 143 mgd and are expected to handle a mean flow of 131 mgd over the 30-year life of the project.

The sand filtration facility downstream of the coagulation and sedimentation process consists of two parallel identical units, as does the disinfection facility below the filters. This makes it possible to coagulate, settle, filter, and disinfect half the wastewater flow through the WPCP for reclamation, while sending the other half directly from nitrification to filtration, disinfection, and discharge. The halves of the filter and disinfection processes cannot be further subdivided economically. The fact that the demand for reclaimed water will at times exceed half the WPCP design flow requires that the coagulation and sedimentation plant be designed for the full 143 mgd plant flow. However, the costs for coagulant chemicals can be reduced significantly by coagulating only half the flow for eight months out of each year. Thus, the design flow for the coagulation and sedimentation facilities is 143 mgd, while the annual expected mean flow is 87 mgd.

The effects of diurnal flow variations on the process will be minimized by use of the existing old primary clarification tanks (currently not in frequent use) as equalization storage for partially treated wastewater. A flow diagram for this process is presented in Figure V-5.

Coagulation and sedimentation facilities will consist of the following:

- 144-inch-diameter gravity piping and valves to divert part or all of the flow from the effluent side of the tertiary nitrification clarifiers.

- A low-lift pumping station with 84-inch diameter discharge header to move the water to the flash mixer. The design flow is 143 gpm with a 30-foot total design head. Seven mixed flow vertical centrifugal pumps will be utilized: two 100 hp units handling 10,000 gpm each and five 200 hp units handling 20,000 gpm each. The pumping station will include a 300,000-gal inlet sump.

- Two parallel identical mechanical flash mix tanks, each designed for 2 minutes detention time at 72 mgd design flow. Each 100,000-gallon rectangular concrete tank will be equipped with 150 hp mechanical turbine mixers. The mixer effluent will be distributed through a 4-foot wide, 10-foot deep concrete channel to the flocculation tanks.

- Ten mechanical paddle-type flocculation tanks. Each tank is 30 feet long by 95 feet wide, divided into two chambers by a perforated baffle wall. Total design retention time is 30 minutes in a volume of 300,000 gallons per tank.

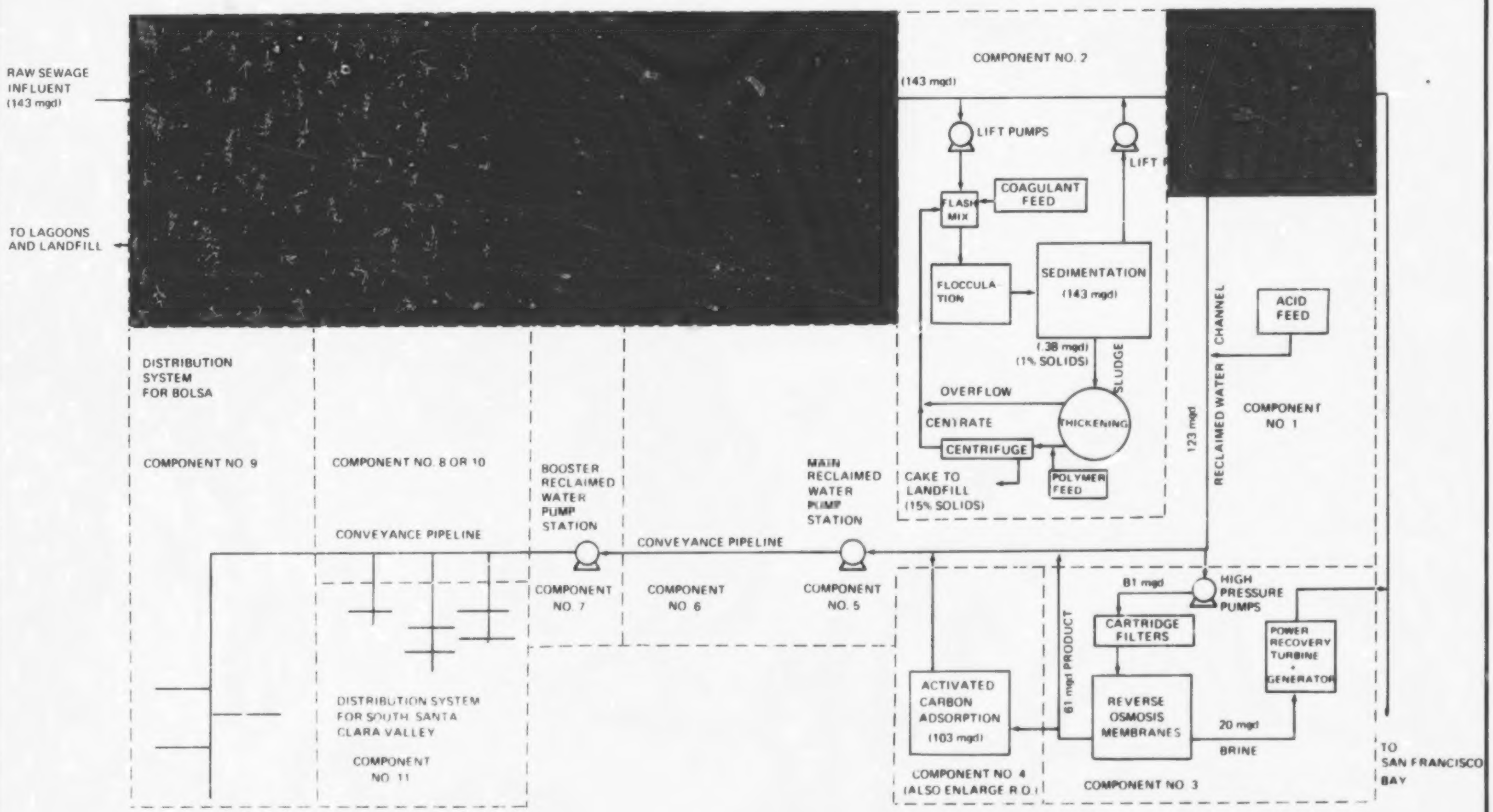

RAW SEWAGE INFLUENT (143 mgd)
TO LAGOONS AND LANDFILL
[redacted]
COMPONENT NO. 2
(143 mgd)
LIFT PUMPS
LIFT P
[redacted]
COAGULANT FEED
FLASH MIX
FLOCCULATION
SEDIMENTATION (143 mgd)
(.38 mgd) (1% SOLIDS)
SLUDGE
OVERFLOW
CENTRATE
THICKENING
CENTRIFUGE
POLYMER FEED
CAKE TO LANDFILL (15% SOLIDS)
ACID FEED
RECLAIMED WATER CHANNEL
123 mgd
COMPONENT NO 1
DISTRIBUTION SYSTEM FOR BOLSA
COMPONENT NO. 9
COMPONENT NO. 8 OR 10
BOOSTER RECLAIMED WATER PUMP STATION
MAIN RECLAIMED WATER PUMP STATION
CONVEYANCE PIPELINE
CONVEYANCE PIPELINE
COMPONENT NO. 7
COMPONENT NO. 6
COMPONENT NO. 5
81 mgd
HIGH PRESSURE PUMPS
CARTRIDGE FILTERS
POWER RECOVERY TURBINE + GENERATOR
61 mgd PRODUCT
ACTIVATED CARBON ADSORPTION (103 mgd)
REVERSE OSMOSIS MEMBRANES
20 mgd
BRINE
TO SAN FRANCISCO BAY
DISTRIBUTION SYSTEM FOR SOUTH SANTA CLARA VALLEY
COMPONENT NO. 11
COMPONENT NO. 4 (ALSO ENLARGE R.O.)
COMPONENT NO. 3

Figure V-3
SOUTH BAY DISCHARGERS AUTHORITY
WASTEWATER RECLAMATION PROJECT
PROCESS FLOW DIAGRAM

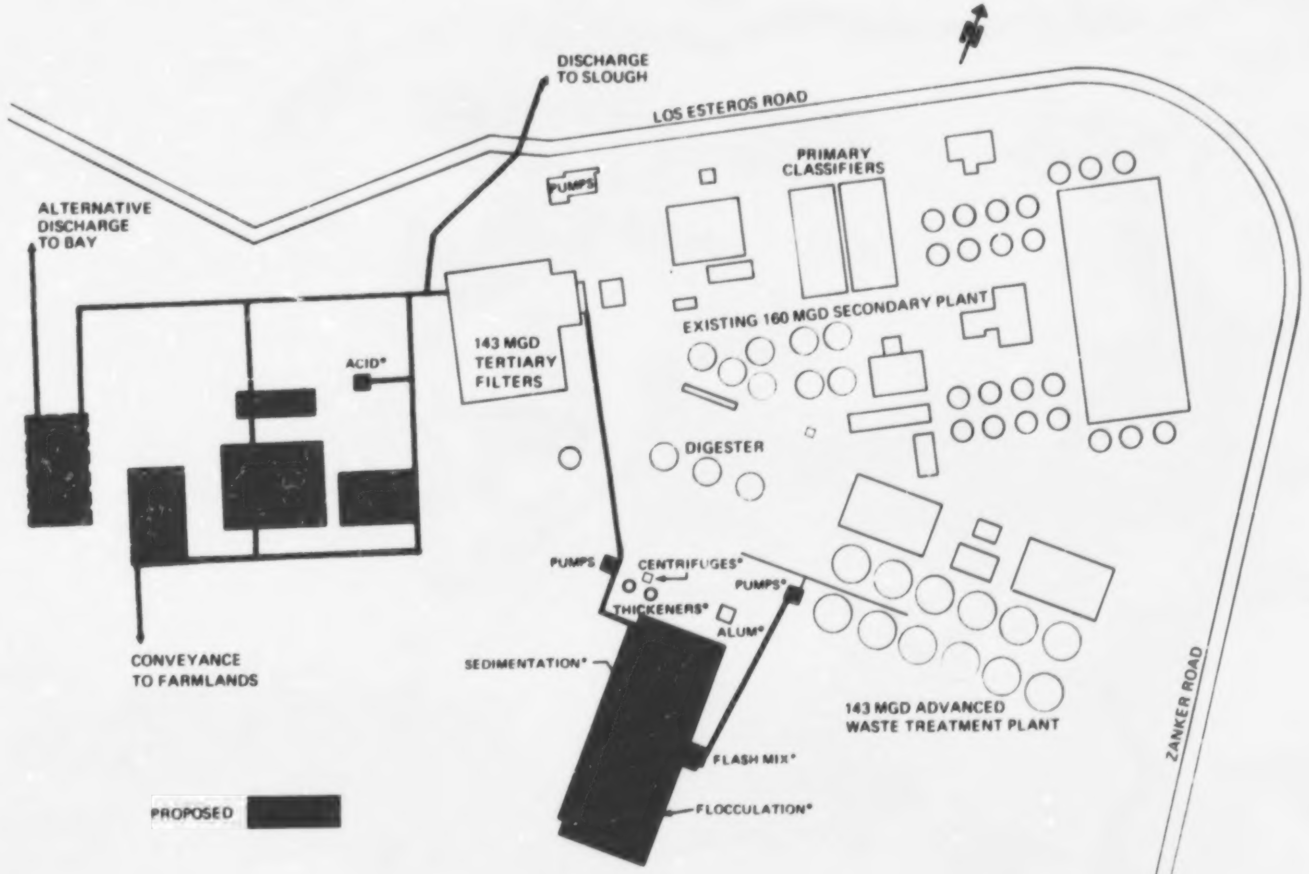

DISCHARGE TO SLOUGH
LOS ESTEROS ROAD
N
ALTERNATIVE DISCHARGE TO BAY
PUMPS
PRIMARY CLASSIFIERS
EXISTING 160 MGD SECONDARY PLANT
143 MGD TERTIARY FILTERS
ACID*
DIGESTER
PUMPS
CENTRIFUGES*
PUMPS*
THICKENERS*
ALUM*
SEDIMENTATION*
CONVEYANCE TO FARMLANDS
143 MGD ADVANCED WASTE TREATMENT PLANT
ZANKER ROAD
FLASH MIX*
FLOCCULATION*
PROPOSED

Figure V-4
PROPOSED RECLAMATION FACILITIES
SAN JOSE – SANTA CLARA
WATER POLLUTION CONTROL PLANT

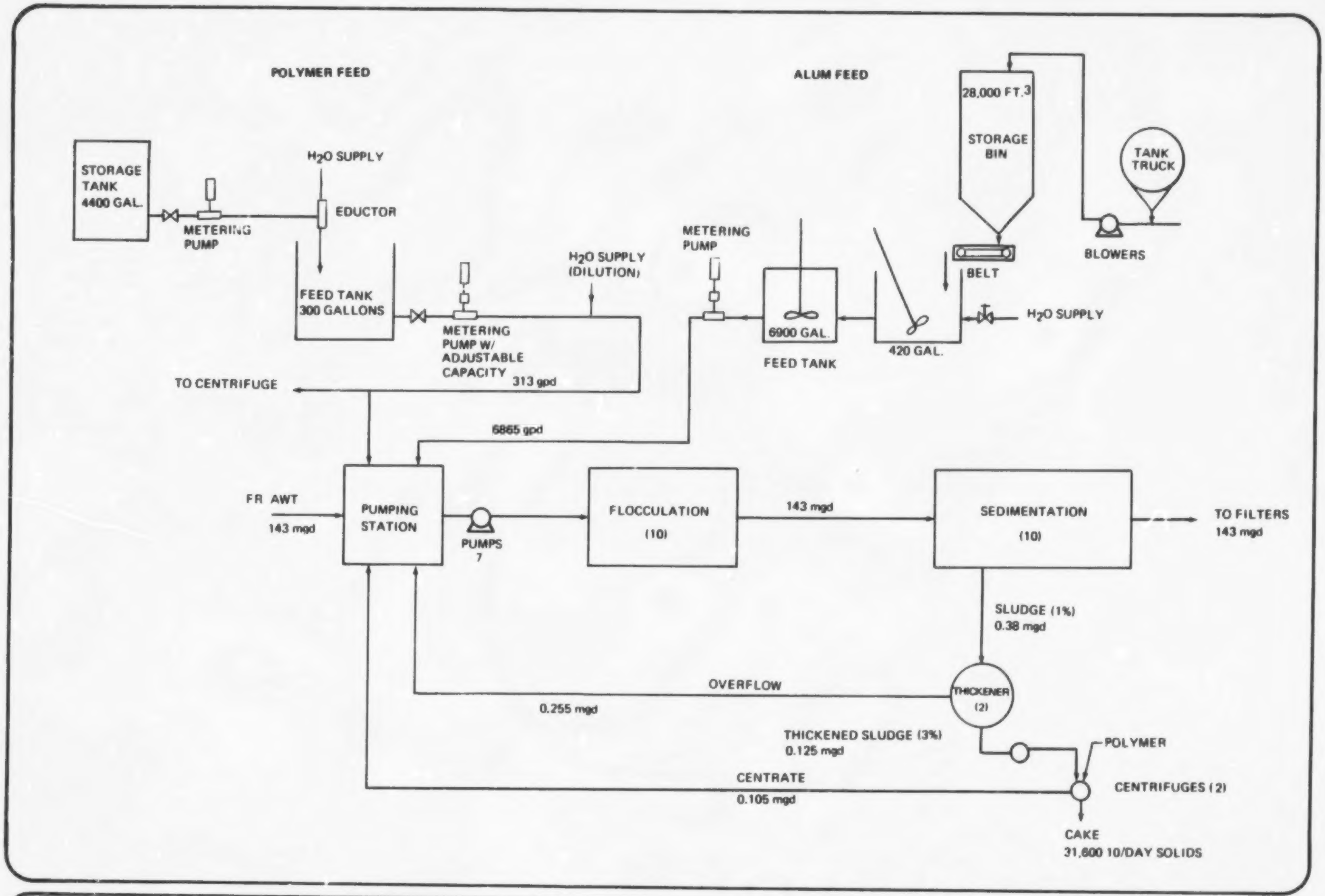

POLYMER FEED
ALUM FEED
STORAGE TANK 4400 GAL.
METERING PUMP
H_2O SUPPLY
EDUCTOR
FEED TANK 300 GALLONS
METERING PUMP W/ ADJUSTABLE CAPACITY
313 gpd
H_2O SUPPLY (DILUTION)
METERING PUMP
6900 GAL.
FEED TANK
420 GAL.
28,000 FT.^{3}
STORAGE BIN
BELT
TANK TRUCK
BLOWERS
H_2O SUPPLY
TO CENTRIFUGE
6865 gpd
FR AWT
143 mgd
PUMPING STATION
PUMPS
7
FLOCCULATION
(10)
143 mgd
SEDIMENTATION
(10)
TO FILTERS
143 mgd
SLUDGE (1%)
0.38 mgd
OVERFLOW
0.255 mgd
THICKENER
(2)
THICKENED SLUDGE (3%)
0.125 mgd
POLYMER
CENTRATE
0.105 mgd
CENTRIFUGES (2)
CAKE
31,600 10/DAY SOLIDS

Figure V-5
COAGULATION AND SEDIMENTATION TREATMENT PROCESS FLOW DIAGRAM

- Ten rectangular sedimentation tanks, equipped with mechanical chain and flight-type sludge collectors. These tanks conform to standard municipal water treatment practice for alum sedimentation. The tanks are each designed for 14.3 mgd with a 550 gpd/foot weir overflow rate. The tanks are built of concrete with commonwall construction and are each 95 feet wide by 15 feet deep by 270 feet long. Hydraulic detention time is approximately 4 hours at design flow. A plan view of five of the sedimentation tanks (half the plant) is shown in Figure V-6. The sedimentation tanks are each equipped with two sludge pumps, one operational and one standby, designed to handle 30 gpm of alum sludge at 1 percent dry solids concentration.

- A second low-lift pumping station and 84-inch diameter discharge header to transfer the sedimentation effluent to the gravity filters. This pumping station will also have seven pumps and will be similar in most respects to the pumping station upstream of the flash mixers (see above).

- Modifications to the existing filters and disinfection facilities to allow separate, parallel treatment of both coagulation and sedimentation effluent and tertiary nitrification clarifier effluent. These modifications will include restructuring the disinfection effluent piping and modifying some controls.

- Two waste sludge thickeners to store and thicken the alum sludge. The units will be circular concrete tanks 15 feet deep and 50 feet in diameter, designed for a solids loading of 10 lb/day-ft^2. Mechanical rake arms will be provided to enhance thickening and aid thickened sludge withdrawal. The hydraulic retention time will be about 24 hours at design loading.

- Three solid bowl scroll continuous operation centrifuges to dewater the sludge for landfill. One machine will be a standby, and each of the others is designed to process half of the design loading of 31,600 lb/day of solids. The thickened sludge, fed to the centrifuges at about 3 percent solids, will be dewatered to 15 percent solids. The units will be mounted on an elevated platform and will discharge cake down into trucks for haul to landfill.

  Centrate will be returned by gravity to the thickeners. The centrifuges will be 24 to 25 inches in diameter by 60 to 70 inches long and will handle 40 to 80 gpm of sludge. Each machine will require a 100 hp drive and motor. Four 50 gpm positive displacement pumps will be provided to feed the centrifuges, two for each thickener.

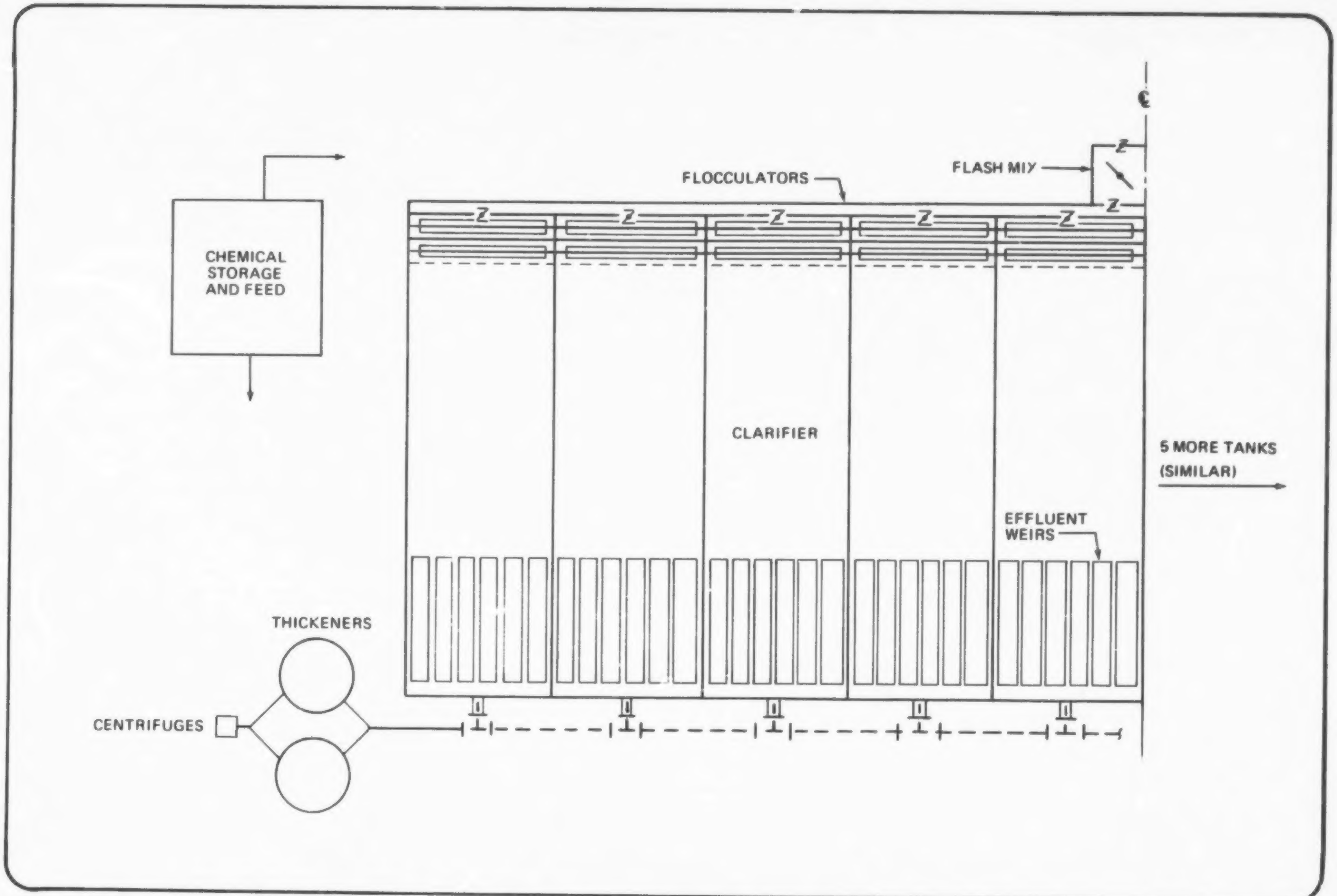
- Chemical storage and feed system. This will include dry alum unloading, storage and feed equipment, alum solution mixing and feed tanks, and alum solution metering pumps and controls. The alum design dosage is 50 mg/l as hydrated alum, and storage will be provided for 30 days.

  In addition to the alum facilities, equipment for storage, dilution, and feeding of liquid anionic or nonionic polymer will be provided. Polymer design dosage is mg/l for flocculation and 4 lb/ton of dry solids for centrifuge feed sludge conditioning. Storage for a 60-day supply is provided.

Alkalinity Control

In order to minimize carbonate scaling in the reverse osmosis process and also to minimize the adverse effect of bicarbonate ion on irrigated plants, sulfuric acid will be added to the wastewater in the channel used to convey disinfected effluent to the reverse osmosis process or to the main reclaimed water pumping station.

The acid addition system will consist of storage tanks, metering pumps that will deliver the acid into dilution tanks where it is mixed with a side stream of disinfected filter effluent, pumps to supply this side stream, and gravity flow feed lines to the reclaimed water channel and the influent to the reverse osmosis



℄
FLASH MIY
FLOCCULATORS
CHEMICAL STORAGE AND FEED
CLARIFIER
5 MORE TANKS (SIMILAR)
EFFLUENT WEIRS
THICKENERS
CENTRIFUGES

Figure V-6
SBDA
COAGULATION AND SEDIMENTATION LAYOUT

feed pumps. Sufficient acid will be provided to neutralize up to 100 mg/l of the alkalinity in the reclaimed water.

Partial Desalination Treatment (Component 3)

In order to produce a reclaimed water flow of 103 mgd, 80.8 mgd of filtered disinfected wastewater is fed to a reverse osmosis plant, producing 60.6 mgd of product water and 20.2 mgd of brine. The product water will then be blended with 42.4 mgd of filtered, disinfected wastewater to produce 103 mgd of reclaimed water; 20.2 mgd of brine will be returned to be mixed with the SBDA effluent. Thus, the desalination process will require a peak flow of 123.2 mgd of filtered, disinfected wastewater under design conditions, as seen in the flow diagram in Figure V-7.

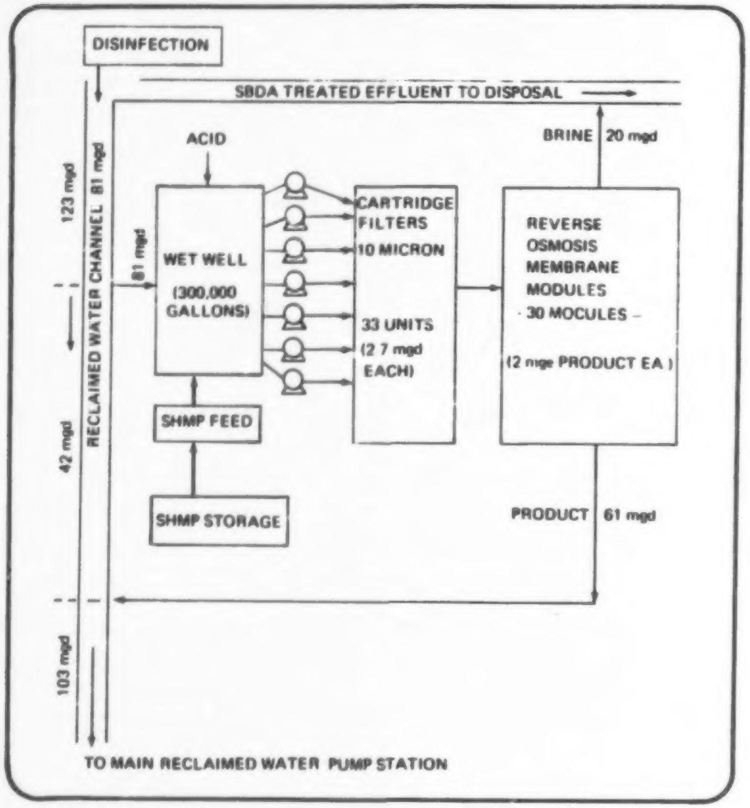

DISINFECTION
SBDA TREATED EFFLUENT TO DISPOSAL
BRINE
20 mgd
ACID
123 mgd
RECLAIMED WATER CHANNEL 81 mgd
81 mgd
WET WELL
(300,000 GALLONS)
CARTRIDGE FILTERS
10 MICRON
33 UNITS
(2 7 mgd EACH)
REVERSE OSMOSIS MEMBRANE MODULES
- 30 MODULES -
(2 mgd PRODUCT EA.)
SHMP FEED
42 mgd
SHMP STORAGE
PRODUCT
61 mgd
103 mgd
TO MAIN RECLAIMED WATER PUMP STATION

Figure V-7
FLOW DIAGRAM
DESALINATION PROCESS

The average daily flows for this process on an annual design basis average 54 mgd of process influent, 35 mgd of reverse osmosis feed flow, 9 mgd of brine flow returned to the SBDA effluent, 19 mgd of blending water, 26 mgd of reverse osmosis product, and 45 mgd of reclaimed water.

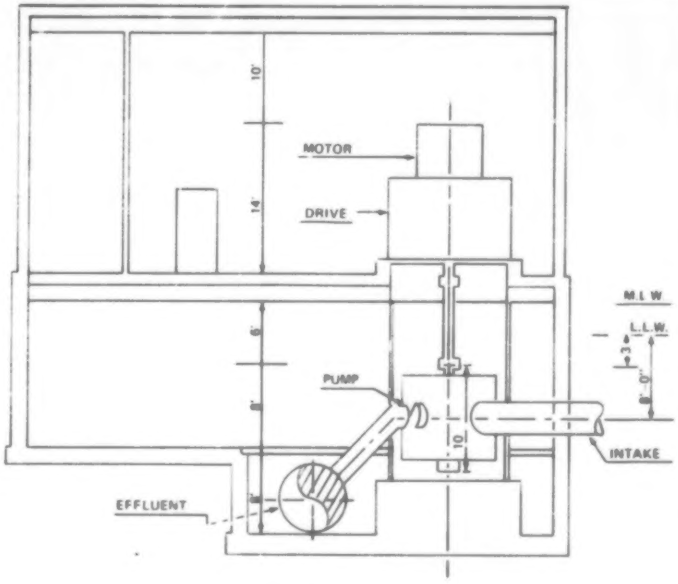
The desalination treatment will consist of:

- High pressure pumping station
- 10 micron cartridge filters with washable elements
- Sodium hexametaphosphate (SHMP) injection and storage equipment
- 30 membrane modules, each capable of producing 2 mgd
- A power recovery turbine operating off the high pressure waste brine stream

The desalination process is designed to produce an effluent of 103 mgd with a TDS of 400 mgd/l. The feed to the system will consist of up to 143 mgd of wastewater with a TDS of 850 mg/l. The conceptual design is based on the use of hollow fine fiber reverse osmosis membranes. An alternative, the use of spiral wound units, would not involve any major changes in the conceptual design or cost estimate.

Feedwater will be pumped to the reverse osmosis membranes at 400 psi through 10 micron cartridge filters.

Optimal performance in terms of fouling characteristics is assumed to occur at 50 percent conversion through one membrane. Under these conditions and using the feedwater analysis presented in Table V-8, (Case B), the overall salt passage is calculated to be 6 percent, based on vendor data. Since operating with 50 percent conversion leaves half the feedwater to be disposed of as brine, and since the brine from a first-stage unit can be sent on to a second-stage with minimal loss of pressure, a two-stage arrangement of membranes is planned. The brine from two first-stage membrane units will be fed to one second-stage membrane unit, where a second 50 percent conversion reverse osmosis operation will raise the overall conversion (product recovery) to 75 percent.



ELEVATION
SCALE 1" = 10'
CONCEPTUAL LAYOUT
MAIN PUMP STATION

Figure V-8
CONCEPTUAL LAYOUT MAIN PUMP STATION

Calculations were made taking into account the effects of water temperature on conversion and on flux decline due to aging of the membrane, which in turn affects conversion. The influence of first- and second-stage brine concentration on conversion and salt passage were also calculated, based on vendor data. Table V-12 expresses the process design resulting from these calculations.

V.3.4 CONVEYANCE AND DISTRIBUTION CONCEPTUAL DESIGNS

Since there are two potential agricultural markets for the reclaimed water, two alternative conveyance and distribution designs were developed: No. 1 serving the south Santa Clara Valley, and No. 2 serving the Bolsa area (other types of markets are described in Section IV.2.3). Since these alternatives have a number of facilities in common, the designs were broken down into components that could be costed separately. Total costs for the systems were determined by adding up the appropriate component costs.

In brief, the proposed method of conveyance of the treated water is to pump the water from the main reclaimed water pumping station through a conveyance pipeline to a booster pumping station near Coyote.

From this point, the water will be pumped through a conveyance line over a high elevation near Morgan Hill and down to a point in San Benito County near the Pajaro River, if supply is to the Bolsa, or to a point near Gilroy, if the supply is to the Santa Clara Valley.

Beginning near Coyote, turnouts will be provided to connect the main conveyance pipeline to distribution pipeline networks in the Santa Clara Valley or the

CONTENTS

Section		Page	
I	DESCRIPTION OF BASIN PLAN AND ALTERNATIVES		
I.1	DESCRIPTION OF ALTERNATIVES	1	1/D13
I.1.1	Introduction	1	1/D13
I.1.2	Background and Objectives	4	1/E5
I.1.3	Criteria for Evaluation of Alternatives	6	1/E9
I.1.4	Evaluation of Alternatives	6	1/E9
	Alternative 2 — No Further Action	9	1/F1
	Alternative 3 — Individual Outfalls to Nearest Deepwater	10	1/F3
	Alternative 4 — Local Discharge with Upgraded Treatment	11	1/F5
	Alternative 5 — Reclamation and Reuse of Treated Wastewater	13	1/F9
I.1.5	Alternative Alignments to Basin Plan Alternative	15	1/F13
I.2	THE BASIN PLAN ALTERNATIVE	19	1/G7
I.2.1	Location	19	1/G7
I.2.2	Facilities for the Basin Plan Alternative	21	1/G11
	San Jose/Santa Clara Pumping Station	22	1/G13
	Pipeline Segment — San Jose Santa Clara to Sunnyvale	22	1/G13
	Sunnyvale Pumping Station	22	1/G13
	Pipeline Segment — Sunnyvale to Palo Alto	24	2/B1
	Palo Alto Pumping Station	24	2/B1
	Pipeline Segment — Palo Alto to Discharge Point	24	2/B1
	Diffuser	24	2/B1
I.2.3	Construction of the Basin Plan Alternative	25	2/B3
	Construction Procedures on Land	25	2/B3
	Construction Procedures in Water	26	2/B5
I.2.4	Operation of the Basin Plan Alternative	28	2/B9
I.3	APPROVALS REQUIRED	29	2/B11
II	ENVIRONMENTAL DESCRIPTION		
II.1	PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT)	31	2/C3
II.1.1	Physical Environment	31	2/C3
	Topography	31	2/C3
	Geology and Seismology	33	2/C7
	Groundwater	33	2/C7
	Soils	36	2/C13
	Sediments	37	2/D1
	Meteorology	39	2/D5
	Air Quality	40	2/D7
	— The Air Pollution Problem in the Bay Area	40	2/D7
	— Emissions and Air Quality	40	2/D7
	— Air Quality in the Bay Area	45	2/E3
	— Air Impacts of Wastewater Disposal	45	2/E3
	Hydrology	45	2/E3
	— Tides and Currents	46	2/E5
	— Circulation and Dispersion	47	2/E7
	Water Quality	49	2/E11
	— Temperature	51	2/F1
	— Transparency	51	2/F1
	— pH	51	2/F1
	— Suspended Solids	51	2/F1
	— Salinity	52	2/F3
	— Dissolved Oxygen and Oxygen Demand	53	2/F5
	— Nutrients	53	2/F5
	— Chlorophyll	54	2/F7
	— Coliform Bacteria	54	2/F7
	— Oil and Grease	55	2/F9
	— Toxicity	55	2/F9
	— Heavy Metals	57	2/F13
	Noise	57	2/F13
II.1.2	Biological Environment	58	2/G1
	South Bay Habitats	58	2/G1
	— Open Water	61	2/G7
	— Tidal Mud Flats	64	2/G13
	— Salt Marsh	68	3/B5
	— Salt Ponds	71	3/B11
	Dikes and Levees	74	3/C3
	— Grasslands	75	3/C5
	— Streams and Sloughs	75	3/C5
	— Freshwater Marshes and Ponds	77	3/C9
	Species of Special Concern	78	3/C11

II.1.3 Social, Economic, and Cultural Environment 83 3/D7
Population and Demography 83 3/D7
Recreational and Scientific Uses of the Area 87 3/E1
Archaeological, Paleontological, Historical and Cultural Resources 88 3/E3
— Archaeological Resources 88 3/E3
— Paleontological Resources 89 3/E5
— Historical and Cultural Resources 89 3/E5
Visuel and Aesthetic Setting 93 3/E13
Economic Setting 98 3/F9
II.2 LAND USE
II.2.1 Present Land-Use Patterns 101 3/G1
Existing Land Use 101 3/G1
— Santa Clara County 101 3/G1
— San Mateo County 104 3/G7
Existing Public and Private Developments 104 3/G7
Mineral Resources of the Baylands 112 4/B7
II.2.2 Projected Land-Use Patterns 112 4/B7
Planned Public and Private Developments 112 4/B7
Land-Use Plans and Planning Agencies 114 4/B11
Interested Agencies 118 4/C5
— Local 118 4/C5
— Regional 118 4/C5
— State 118 4/C5
— Federal 119 4/C7
II.3 WATER USE
II.3.1 Existing and Proposed Wastewater Treatment Facilities 120 4/C9
San Jose/Santa Clara Regional Water Pollution Control Plant 120 4/C9
Sunnyvale Water Pollution Control Plant 120 4/C9
Palo Alto Treatment Plant 121 4/C11
Menlo Park Sanitary District Wastewater Treatment Plant 121 4/C11
Redwood City Sanitary District — Redwood City Sewage Treatment Facility 121 4/C11
Redwood City Sanitary District — Redwood Shores Plant 122 4/C13
Belmont/San Carlos Joint Sewage Treatment Facility 122 4/C13
Proposed Redwood Shores Subregional Plant 122 4/C13
Union Sanitary District — Alvarado, Plant No. 3 122 4/C13
Union Sanitary District — Newark, Plant No. 1 122 4/C13
Union Sanitary District — Irvington, Plant No. 2 122 4/C13
II.3.2 Current and Projected Sources of Water 122 4/C13
II.3.3 Current Water Use and Projected Demand 123 4/D1
II.3.4 Current and Projected Water Quality 123 4/D1
III ENVIRONMENTAL IMPACTS
III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129 4/E1
III.1.1 Construction Impacts 129 4/E1
Physical Environment 129 4/E1
— Topography 129 4/E1
— Air Quality 130 4/E3
— Water Quality 131 4/E5
— Sediment Quality 132 4/E7
— Noise 132 4/E7
Biological Environment 133 4/E9
— Segment I — San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134 4/E11
— Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant 136 4/F1
— Segment III — Palo Alto Treatment Plant to Discharge Point 138 4/F5
Social, Economic, and Cultural Environment 140 4/F9
— Recreational Uses of the Area 140 4/F9

  - Archaeological, Paleontological, and Historical Resources 141 4/F11
  - Visual and Aesthetic Setting 141 4/F11
  - Economic Setting 141 4/F11
  - Present Land-Use Patterns 143 4/G1
  - Projected Land-Use Patterns 144 4/G3

III.1.2 Operation Impacts 144 4/G3
  Physical Environment 144 4/G3
  - Hydrology 144 4/G3
  - Water Quality 144 4/G3
  - Sediment Quality 148 4/G11
  - Noise 150 5/A13
  Biological Environment 152 5/B3
  Social, Economic, and Cultural Environment 154 5/B7
  - Recreational Uses of the Area 154 5/B7
  - Visual and Aesthetic Setting 155 5/B9
  - Present and Future Land-Use 155 5/B9
  - Energy Consumption 155 5/B9

III.1.3 Economic Impact of the Basin Plan Alternative 155 5/B9
  Introduction 155 5/B9
  Study Assumptions and Methodology 155 5/B9
  - Capital Costs 156 5/B11
  - Operation and Maintenance Costs 158 5/C1
  Computation of Allocation Factors 158 5/C1
  User Charges to Discharger Groups 159 5/C3
  - Residential Dischargers 159 5/C3
  - Commercial Dischargers 159 5/C3
  - Industrial Dischargers 159 5/C3
  - Direct Impact on Industrial Dischargers 162 5/C9
  Analysis of the Canned Fruit and Vegetable Industry 163 5/C11
  - Industry Characteristics 163 5/C11
  - Methodology 164 5/C13
  - Conclusions of Analysis 165 5/D1
  Conclusions 165 5/D1

III.1.4 Accident or Natural Catastrophe 166 5/D3
  Flooding 166 5/D3
  Earthquake 166 5/D3
  Plant Upset 166 5/D3
  Pumping Station Malfunction 166 5/D3

III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168 5/D7
  III.2.1 Adverse Construction Effects 168 5/D7
    Physical Environment 168 5/D7
    Biological Environment 168 5/D7
    Social, Economic, and Cultural Environment 168 5/D7
  III.2.2 Adverse Operational Effects 169 5/D9
    Physical Environment 169 5/D9
    Biological Environment 169 5/D9
    Social, Economic, and Cultural Environment 169 5/D9

III.3 MITIGATION MEASURES 170 5/D11
  III.3.1 Mitigation of Construction Impacts 170 5/D11
    Proposed Measures 170 5/D11
    Potential Measures 172 5/E2
  III.3.2 Mitigation of Operation Impacts 173 5/E3
    Proposed Measures 173 5/E3
    Potential Measures 173 5/E3

III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174 5/E5
  III.4.1 Short-Term Uses of Man's Environment 174 5/E5
  III.4.2 Maintenance and Enhancement of Long-Term Productivity 174 5/E5
  III.4.3 Need for the Project 175 5/E7

III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176 5/E9
  III.5.1 Permanent Changes in Land Features and Land Use 177 5/E11
  III.5.2 Biological Systems 177 5/E11
  III.5.3 Assimilative Capacity of the Bay 177 5/E11
  III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177 5/E11

III.6 GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178 5/E13

IV ALTERNATIVES TO THE BASIN PLAN

  IV.1 INTRODUCTION 181 5/F7
  IV.2 ALTERNATIVES 182 5/F9

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183 5/F11
  Participation by Other Entities 184 5/F13
  Alternative Alignments 184 5/F13
  Result of Screening 185 5/G1
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188 5/G7
  Result of Screening 190 5/G11
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190 5/G11
  Result of Screening 191 5/G13
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193 6/B1
  Result of Screening 195 6/B5
IV.2.5 Alternative 5 — Reclamation and Reuse 195 6/B5
  Reclamation in Santa Clara County 197 6/B9
  Smaller Reuse Markets in the Service Area 199 6/B13
  Markets Outside the Service Area 201 6/C3
  Result of Screening 202 6/C5
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202 6/C5
  Result of Screening 203 6/C7
IV.2.7 Alternative 7 - Discharge to the Ocean 203 6/C7
  Result of Screening 204 6/C9
IV.2.8 Alternative 8 — Land Disposal 204 6/C9
  Result of Screening 205 6/C11
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206 6/C13
  Result of Screening 206 6/C13
V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION
V.1 INTRODUCTION 207 6/D3
V.2 STUDY AREA 209 6/D7
V.2.1 Location of Study Area 210 6/D9
V.2.2 Water Demand and Supply 210 6/D9
V.2.3 Quality of Groundwater Supplies 213 6/E1
V.2.4 Quality of Soils 213 6/E1
V.2.5 Agricultural Land Use 215 6/E5
V.3 CONCEPTUAL DESIGN 217 6/E9
V.3.1 Potential Markets 218 6/E11
V.3.2 Reclaimed Water Quality 219 6/E13
  Source Control 221 6/F3
  Level of Reclaimed Water Treatment 222 6/F5
V.3.3 Treatment Conceptual Designs 224 6/F9
  Reclaimed Water Flow Diversion 226 6/F13
  Coagulation and Sedimentation with Alkalinity Control 226 6/F13
  Alkalinity Control 230 6/G7
  Partial Desalination Treatment 232 6/G11
V.3.4 Conveyance and Distribution Conceptual Designs 233 6/G13
  Pumping 234 7/A13
  Conveyance Pipeline 235 7/B1
  Santa Clara Valley Distribution System 236 7/B3
  Bolsa Distribution System 236 7/B3
  User Connections 236 7/B3
V.3.5 Cost Estimates 242 7/C1
  Basis of Estimate 242 7/C1
  Engineering Construction Management Contingency 244 7/C5
  Escalation 244 7/C5
  Schedule 244 7/C5
  Operation and Maintenance 244 7/C5
  Major Exclusions 244 7/C5
  Assumptions 244 7/C5
V.3.6 Blending Alternatives 244 7/C5
  Blended Water Quality 245 7/C7
  Blended Water Markets 245 7/C7
  Blended Water Distribution 246 7/C9
  Blending System Alternatives 247 7/C11
V.3.7 Alternating Supply Alternatives 247 7/C11
V.3.8 Summary 248 7/C13
V.4 AGRICULTURAL IMPACTS 249 7/D1
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250 7/D3
  Salinity Effects 251 7/D5
  Effects of High Sodium Concentrations 253 7/D9

Specific Ion Toxicity 255 7/D13
Summary of Effects on Agriculture of Cases A and B 255 7/D13
V.4.2 Impact of Cases C, D, B_1, B_2, and B_3 in the Santa Clara County Portion of the Study Area 256 7/E1
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257 7/E3
V.5 ECONOMIC IMPACT ANALYSIS 259 7/E7
V.5.1 Conceptual Level Costs 259 7/E7
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260 7/E9
V.5.3 Economic Impact on Agriculture 260 7/E9
V.6 OTHER IMPACTS 263 7/F1
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264 7/F3
V.6.2 Long-Term Buildup of Salts in Soil 265 7/F5
V.6.3 Public Health Concerns 265 7/F5
V.6.4 Effects on Land Use and Water Use 266 7/F7
V.6.5 Energy Consumption 266 7/F7
V.6.6 Other Effects 267 7/F9

VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270 7/G3
VI.1.1 Disposal of Bittern 271 7/G5
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272 7/G7
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273 7/G9
VI.1.4 Other Disposal Alternatives 276 8/A13
Continued Storage 276 8/A13
On-Land Dilution 276 8/A13
VI.2 PRESENT ENVIRONMENT 277 8/B1
VI.2.1 Physical Environment 277 8/B1
Topography 277 8/B1
Soils 278 8/B3
Sediments 278 8/B3
Hydrology 278 8/B3
Water Quality 278 8/B3
– Temperature and Salinity 278 8/B3
– Chemical Characteristics 280 8/B7
VI.2.2 Biological Environment 280 8/B7
Open Water and Tidal Mud Flats 280 8/B7
Salt Marsh 280 8/B7
Salt Ponds 280 8/B7
Dikes and Levees 282 8/B11
Streams and Sloughs 282 8/B11
Species of Special Concern 283 8/B13
VI.2.3 Social and Cultural Environment 283 8/B13
Recreational Uses of the Area 283 8/B13
Archaeological, Paleontological, Historical, and Cultural Resources 284 8/C1
Visual and Aesthetic Setting 284 8/C1
Existing and Proposed Land Use 284 8/C1
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285 8/C3
VI.3.1 Discharging to Basin Plan Alternative 285 8/C3
Construction Impacts – Physical Environment 285 8/C3
– Topography 285 8/C3
– Air Quality 285 8/C3
– Water Quality 286 8/C5
– Sediment Quality 286 8/C5
– Noise 286 8/C5
Construction Impacts – Biological Environment 286 8/C5
– Salt Pond Dikes 286 8/C5
– Open Water 286 8/C5
Construction Impacts – Social, Economic, and Cultural Environment 287 8/C7
– Recreational Uses of the Area 287 8/C7
– Archaeological, Paleontological, and Historical Resources 287 8/C7
– Economic Setting 287 8/C7
– Present and Projected Land-Use Patterns 287 8/C7
Operational Impacts – Physical Environment 287 8/C7
– Water Quality 287 8/C7
– Sediment Quality 290 8/C13
– Noise 290 8/C13
Operational Impacts – Biological Environment 291 8/D1

Operational Impacts — Social, Economic, and Cultural Environment 292 8/D3
— Economic Setting 292 8/D3
VI.3.2 Discharging Through Separate Diffusers 292 8/D3
Construction Impacts — Physical Environment 292 8/D3
— Topography 292 8/D3
— Air Quality 292 8/D3
— Water Quality 292 8/D3
— Sediment Quality 292 8/D3
— Noise 292 8/D3
Construction Impacts — Biological Environment 293 8/D5
— Salt Pond Dikes 293 8/D5
— Open Water 293 8/D5
Construction Impacts — Social, Economic, and Cultural Environment 293 8/D5
- Recreational Uses of the Area 293 8/D5
— Visual and Aesthetic Setting 293 8/D5
— Economic Setting 293 8/D5
— Present and Projected Land-Use Pattern 294 8/D7
Operational Impacts — Physical Environment 294 8/D7
— Water Quality 294 8/D7
— Sediment Quality 295 8/D9
— Noise 295 8/D9
Operational Impacts - Biological Environment 296 8/D11
Operational Impacts — Social, Economic, and Cultural Environment 297 8/D13
— Economic Setting 297 8/D13
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298 8/E1
VI.4.1 Unavoidable Adverse Environmental Impacts 298 8/E1
VI.4.2 Mitigation Measures 298 8/E1
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299 8/E3
Short-Term Uses of Man's Environment 299 8/E3
Maintenance or Enhancement of Long-Term Productivity 299 8/E3
Need for the Project 299 8/E3
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302 8/E9
Permanent Changes in Land Features and Land Use 302 8/E9
Biological Systems 302 8/E9
Assimilative Capacity of the Bay 302 8/E9
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302 8/E9
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302 8/E9

VII SOURCES OF INFORMATION

VII.1 REFERENCES 305 8/F1
VII.1.1 Literature Cited in Text 305 8/F1
VII.1.2 Literature Cited in Figures 312 8/G1
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313 8/G3
VII.3 CONTACTS 316 8/G9
VII.4 DISTRIBUTION LIST 335 9/D3
VII.4.1 Federal Agencies 335 9/D3
VII.4.2 Libraries 338 9/D9
VII.4.3 Individuals and Private Groups 339 9/D11
VII.4.4 State Agencies 347 9/E13
VII.4.5 Regional Agencies and Local Government 348 9/F1
VII.4.6 Legislators 352 9/F9
VII.4.7 News Media 353 9/F11

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

Table V-12

REVERSE OSMOSIS DESIGN

	First Stage	Second Stage	Overall
Conversion (%)	51	49	75
Salt Passage (%)	7	8	10
Feed TDS (mg/l)	850	1,672	850
Feed Flow (mgd)	80.8	39.6	80.8
Product TDS (mg/l)	60	134	85
Product Flow (mgd)	41.2	19.4	60.6
Brine TDS (mg/l)	1,672	3,150	3,150
Brine Flow (mgd)	39.6	20.2	20.2
Blend Water Flow (mgd)	–	–	42.4
Blend Water TDS (mg/l)	–	–	850
Process Efficiency Flow (mgd)	–	–	103
Process Efficiency TDS (mg/l)	–	–	400
No. of 8 in. diameter, 48 in. long Permeator Tubes	3,840	1,920	5,760
Product Flow/Permeator (gpd)	10,730	10,104	–

Bolsa area. The distribution pipelines will carry the water to distribution points scattered throughout the agricultural areas so that the average distance from any distribution point to the intake of any farmer's irrigation system is 1/4 mile. The water will be supplied to the distribution points at 10 to 20 psi pressure in sufficient quantity for normal irrigation of the adjacent acreage.

The components of the conveyance and distribution systems include (Table V-10):

5. Main pumping station
6. Conveyance pipeline between pumping stations
7. Booster pumping station
8. Conveyance pipeline from booster station serving Bolsa
9. Bolsa area distribution system
10. Conveyance pipeline from booster station serving south Santa Clara Valley
11. Santa Clara Valley distribution system

A general discussion of the design of these components is presented below, and these components are identified on the flow diagram in Figure V-5.

Pumping (Components 5 and 7)

Two pumping stations of equal capacity will be provided. These will be similar in terms of hydraulics, although the main station must have two stories to allow for a vertical, motor-pump alignment, while the booster station can be set up with a more compact horizontal arrangement. Conceptual plans of the main station are shown in Figures V-8 and V-9.

The design of the pumping stations is essentially that developed in the Consoer-Bechtel "Conceptual Development" reports (1974a and 1974b), except that the pipe sizes and design flows have been adjusted slightly. Also, since the pumping stations will be pumping only a portion of the effluent from the treatment plant, and since the advanced wastewater treatment will damp out most of the diurnal flow variations, a large forebay for equalization of the main pumping station influent will not be required.

Four 35 mgd pumps will be installed in each station, and a space will be left for a possible fifth pump to be considered in the future. Three pumps will be on active duty with one as standby.

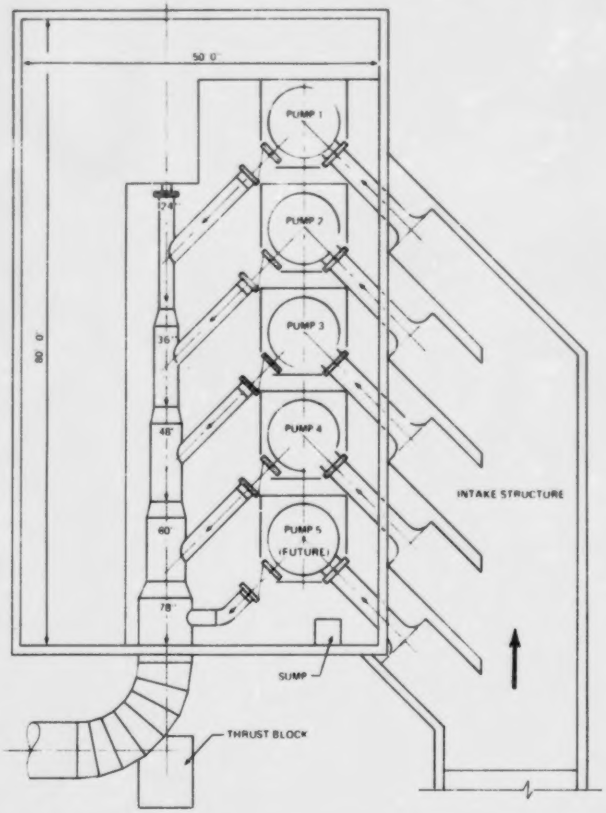


Figure V-9
CONCEPTUAL PLAN VIEW OF MAIN PUMP STATION – LOWER LEVEL

All pumps in either station will meet the following specifications:

Capacity:	35 mgd, clean water
Total Design Head:	400 feet of water
Power:	3,000 hp
Type:	36 x 24 in. split-case, double suction (bottom suction)
Mounting:	Vertical drive shaft for main station horizontal drive for booster
Suction Head:	6 to 8 feet of water
Drive Type:	Variable speed hydraulic or fluid clutch type drive
Prime Mover:	Electric motor

Conveyance Pipeline (Component 10)

The conveyance pipeline will consist of a pressure pipeline of uniform diameter running from the SJ/SC WPCP to a point at the edge of the Bolsa area where Route 25 crosses the Pajaro River. The general alignment, as derived from DWR (1976), is shown in Figure V-9. The pipeline will be 235,000 feet long, or roughly 45 miles. The first 18 miles (100,000 feet) will be buried under 15 feet of cover to prevent interference with other utilities in the metropolitan area of San Jose. The remainder will be under 4 feet of cover.

The pipeline will be constructed of prestressed concrete cylinder pipe. The fall of the land southeast of Morgan Hill to the Pajaro River is at a rate of about 0.3 percent. Selecting this same value for the slope of the hydraulic gradient over this portion of the pipeline will make it easier to maintain reasonably constant delivery pressures throughout the distribution system. Using the Hazen-Williams equation with a C value of 100, a pipe of 66 inches in diameter corresponds to a flow of 103 mgd and a friction head loss of approximately 0.3 foot/100 feet. This is the pipe size suggested in the DWR report.

If the pipeline were to be operated continually at 103 mgd, it would be proper to enlarge the portion of the pipeline extending up to Morgan Hill, as suggested in the Consoer-Bechtel (1974a and 1974b) reports. However, since the pipeline flow will average only 45 percent of capacity over the course of each year, savings in total annual costs can be realized by reducing capital costs somewhat at the expense of operating costs. Therefore, a diameter of 66 inches was selected for the entire conveyance pipeline.

Air release valves and isolation valves (shutoff valves) will both be spaced along the pipe every 2 miles.

If water is not to be distributed to the Bolsa area, the pipe sizes in the conveyance line can be reduced in the section south of the booster station. In addition, the total length can be shortened by 35,000 feet. The design of the 100,000 feet of conveyance line south of the booster pumping station will be essentially the same as that presented in the California DWR (1976) report, consisting of 20,000 feet each of 66, 60, 54, 45, and 33 inch diameter concrete pipe under 4 feet of cover.

Santa Clara Valley Distribution System (Component 11)

The distribution system developed in the DWR (1976) report for the Santa Clara Valley is assumed to be appropriate for this design. Figure V-10 shows a schematic diagram of this distribution system. Table V-13 shows the pipe sizes, flows, and other design characteristics for the system. All distribution piping is assumed to be reinforced concrete pipe capable of operating at 80 psig. Pressure reducing valves will be used at turnouts from the conveyance pipeline north of Morgan Hill to ensure that distribution line pressures stay below this value. Six such valves will be required. Over the whole length of the Santa Clara Valley system, 13 turnouts will be required, each including one shutoff valve.

Bolsa Distribution System (Component 9)

The Bolsa area covers some 40 square miles and is, for the purposes of this design, essentially flat. Slopes of less than 0.1 percent are typical. The distribution pipelines will be aligned along major roads to make use of existing rights-of-way. As in the case of the Santa Clara Valley system, the distribution lines are sized for the maximum monthly flow rate with design velocities between 2 and 6 fps, with the higher velocities in the central trunk lines subject to less flow variation. The flow through each section of pipe was calculated based on the average served by the section of those pipe sections downstream. Based on a maximum monthly flow rate of 103 mgd (160 cfs) and a total arable acreage of 20,000 acres, the system is designed to supply a flow of 0.008 cfs per acre. Figure V-11 diagrams the layout of the piping system in the Bolsa area, and Table V-14 lists the pipe sizes and flows.

The valve should be located at the junction of the service connection and the distribution pipeline or at the high point in the field. The user connection pipelines will be constructed of low pressure pipe, concrete, clay or PVC, whichever is least expensive. In the worst case in the Bolsa, the delivery pressure at the outlet end of the user connection will be (33 - 26) 7 feet of head. This is sufficient for surface irrigation. Farmers using spray irrigation will have to use booster pumps, as they do now when using well water. Available delivery pressures in the Santa Clara Valley service area will be higher than in the Bolsa area, normally at least 40 feet.

User Connections

Each 40-acre unit of agricultural land in the Santa Clara Valley and Bolsa areas will require a service connection to be put in at the expense of the individual user. While these connections are not included in the cost estimate for this study, the nature of the connections affects the design of the distribution system. Based on a maximum irrigation rate of 4 inches per day, assuming that most farmers should be able to apply this flow to 1/4 of a 40 acre land unit in a 24-hour period, the maximum service connection demand was set at 800 gpm. An 8-inch diameter pipe will be

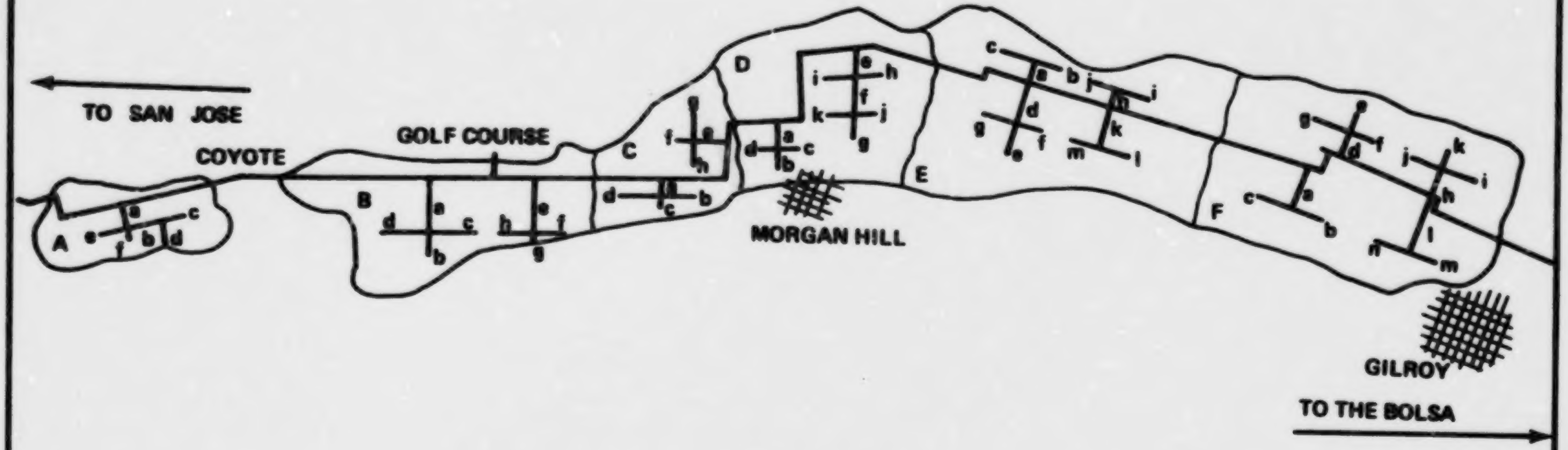

TO SAN JOSE
COYOTE
GOLF COURSE
A
a
b
c
d
e
f
B
a
b
c
d
e
f
g
h
C
a
b
c
d
e
f
g
h
D
a
b
c
d
e
f
g
h
i
j
k
MORGAN HILL
E
a
b
c
d
e
f
g
h
i
j
k
l
m
F
a
b
c
d
e
f
g
h
i
j
k
l
m
n
GILROY
TO THE BOLSA

Figure V-10
SANTA CLARA DISTRIBUTION SYSTEM

Table V-13

DESIGN CHARACTERISTICS OF SANTA CLARA VALLEY WASTEWATER DISTRIBUTION SYSTEM

Irrigation Area	Wastewater Demand (acre-ft/year	Pipeline Section(1)	Pipeline Demand (acre-ft/year	Pipeline Flow (acre-ft/month	cfs	Pipe Diameter (inches)	Velocity (fps)	Pipe Length (1,000 ft)	Head Loss (ft)	Cumulative Head Loss (ft)
A	6,000	a	6,000	1,140	19.0	36	2.69	2.5	1.9	1.9
		b	2,000	380	6.4	21	2.66	3.5	4.9	6.8
		c	1,000	110	3.2	15	2.61	2.5	4.9	11.7
		d	1,000	190	3.2	15	2.61	2.0	3.9	10.7
		e	2,000	380	6.4	21	2.66	3.0	4.2	6.1
		f	2,000	380	6.4	21	2.66	2.0	2.8	4.7
B	7,000	a	3,000	570	9.5	24	3.02	2.0	2.9	2.9
		b	1,000	190	3.2	15	2.61	3.5	6.9	9.8
		c	1,000	190	3.2	15	2.61	3.0	5.9	8.8
		d	1,000	190	3.2	15	2.61	3.0	5.9	8.8
		e	3,000	570	6.4	21	2.66	2.0	2.8	2.8
		f	1,000	110	3.2	15	2.61	3.5	6.9	9.7
		g	1,000	190	3.2	15	2.61	2.0	3.9	6.7
		h	1,000	190	3.2	15	2.61	3.0	5.9	8.7
		i	1,000	190	3.2	15	2.61	2.0	3.9	3.9
C	7,000	a	3,000	570	9.5	24	3.02	1.2	1.8	1.8
		b	1,000	190	3.2	15	2.61	3.0	5.9	7.7
		c	1,000	190	3.2	15	2.61	1.5	2.9	4.7
		d	1,000	190	3.2	15	2.61	2.0	3.9	5.7
		e	4,000	760	12.7	27	3.19	2.5	3.5	3.5
		f	2,000	380	6.4	21	2.66	3.5	4.9	8.4
		g	1,000	190	3.2	15	2.61	3.0	5.9	9.4
		h	1,000	190	3.2	15	2.61	1.5	2.9	6.4
D	10,000	a	4,000	760	12.7	27	3.19	2.7	3.8	3.8
		b	1,000	380	6.4	21	2.66	1.5	2.1	5.9
		c	1,000	190	3.2	15	2.61	2.0	3.9	7.7
		e	6,000	1,140	19.0	36	2.69	2.5	1.9	1.9
		f	4,000	760	12.7	27	3.19	2.0	2.8	7.5
		h	1,000	190	3.2	15	2.61	2.0	3.9	5.8
		i	1,000	190	3.2	15	2.61	2.0	3.9	5.8
		j	1,000	190	3.2	15	2.61	2.0	3.9	5.8
		k	1,000	190	3.2	15	2.61	2.0	3.9	5.8

Table V-13 (continued)

Irrigation Area	Wastewater Demand (acre-ft/year	Pipeline Section(1)	Pipeline Demand (acre-ft/year	Pipeline Flow (acre-ft/year	cfs	Pipe Diameter (inches)	Velocity (fps)	Pipe Length (1,000 ft)	Head Loss (ft)	Cumulative Head Loss (ft)
E	10,000	a	2,000	380	6.4	21	2.66	2.7	–(2)	–(2)
		b	1,000	190	3.2	15	2.61	2.0	–	–
		c	1,000	190	3.2	15	2.61	2.5	–	–
		d	3,000	510	9.5	24	3.02	1.5	–	–
		e	1,000	190	3.2	15	2.61	1.5	–	–
		f	1,000	190	3.2	15	2.61	2.0	–	–
		g	1,000	190	3.2	15	2.61	3.0	–	–
		h	3,000	570	9.5	24	3.02	3.5	–	–
		i	1,000	190	3.2	15	2.61	2.0	–	–
		j	1,000	190	3.2	15	2.61	2.0	–	–
		k	2,000	380	6.4	21	2.66	1.5	–	–
		l	1,000	190	3.2	15	2.61	2.0	–	–
		m	1,000	190	3.2	15	2.61	2.5	–	–
F	10,000	a	2,000	380	6.4	21	–(2)	1.5	–	–
		b	1,000	190	3.2	15	–	2.0	–	–
		c	1,000	190	3.2	15	–	2.0	–	–
		d	3,000	570	9.5	24	–	2.5	–	–
		e	1,000	190	3.2	15	–	1.5	–	–
		f	1,000	190	3.2	15	–	2.0	–	–
		g	1,000	190	3.2	15	–	2.0	–	–
		h	3,000	570	9.5	24	–	3.0	–	–
		i	1,000	190	3.2	15	–	2.0	–	–
		j	1,000	190	3.2	15	–	2.0	–	–
		k	1,000	190	3.2	15	–	1.5	–	–
		l	2,000	380	6.4	21	–	2.5	–	–
		m	1,000	190	3.2	15	–	2.0	–	–
		n	1,000	190	3.2	15	–	2.0	–	–

Note:
(1) See Figure V-10.
(2) DWR did not provide values for these velocities, head loss, or cumulative head loss.

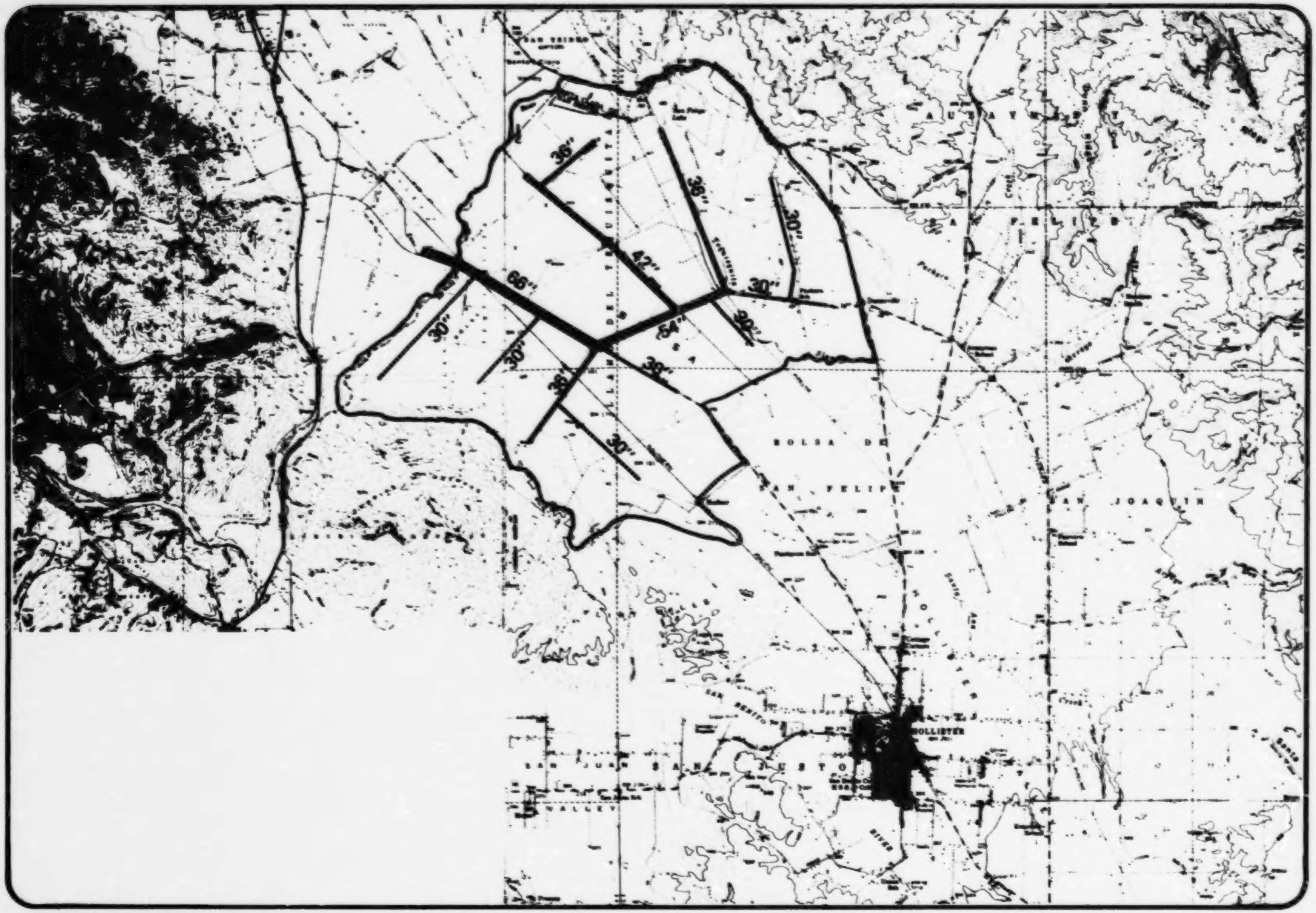

36"
36"
30"
42"
66"
30"
30"
54"
30"
30"
36"
30"
36"
30"
BOLSA DE SAN FELIPE
SAN JOAQUIN
HOLLISTER
SAN JUAN
SAN JUSTO
SAN BENITO
RIVER

Figure V-11
MAP 2
DISTRIBUTION SYSTEM
SAN BENITO COUNTY, BOLSA AREA

Table V-14

BOLSA DISTRIBUTION SYSTEM

Pipeline Section	Acreage Served (acres)	Pipeline Flow (cfs)	Pipe Diameter (inches)	Flow Velocity (fps)	Pipeline Length (ft)	Head Loss(1) (ft)	Inlet Head (ft)	Outlet(2) Head (ft)
a	1,300	151.2	66	6.4	5,560	12.5	80.0	67.5
b	1,000	132.0	66	5.5	5,000	10.6	67.5	56.9
c	700	88.8	54	5.6	5,560	13.8	56.9	43.1
d	600	52.0	54	3.3	5,000	4.9	43.1	38.2
e	600	24.8	36	3.5	4,100	6.7	38.2	31.5
f	800	6.4	30	1.3	3,100	1.1	31.5	30.4
g	1,700	13.6	36	1.9	8,000	4.6	31.5	26.9
h	2,000	16	36	2.3	13,200	9.9	38.2	28.3
i	1,700	31.2	42	3.2	8,930	10.9	43.1	32.2
j	600	4.8	30	1.0	2,640	0.6	32.2	31.6
k	1,600	12.8	36	1.8	11,600	5.8	32.2	26.4
l	1,100	8.8	30	1.8	11,200	7.3	80.0	72.7
m	1,100	8.8	30	1.8	7,800	5.1	67.5	62.4
n	600	23.2	36	3.3	5,300	8.0	56.9	48.9
o	700	5.6	30	1.1	3,500	0.8	48.9	48.1
p	1,600	12.8	30	2.6	8,950	10.7	48.9	38.2
q	1,500	12	30	2.4	8,100	8.9	56.9	48.0
r	800	6.4	30	1.3	5,350	1.9	38.2	36.3

Notes:

(1) Using Hazen-Williams equation with C = 100.
(2) Assumes Bolsa land elevation = 200 feet; hydraulic gradeline at Pajaro River = 280 feet.

required to carry this flow at a velocity of 5 fps. The head loss will be about 2 feet per 100 feet, which over the one quarter mile average length of each service connection will result in about 25 feet of head loss. Each user connection will include a shutoff valve.

V.3.5 COST ESTIMATES

As explained earlier, four alternative treatment processes and two alternative conveyance and distribution systems are being considered for this project. To eliminate redundancy and simplify cost estimating procedures, the various treatment and distribution systems were broken up into the components listed in Table V-10. Cost estimates were prepared for each of these components (Table V-15) and totaled for each of the alternative systems.

Basis of Estimate

An order of magnitude estimate was made for each of the various components. The pricing was based on mid-year 1977 price levels. The basis of the costs for the components are as follows:

- Component 1 — Reclaimed Water Flow Diversion and Tie-In. The pricing was based on a rough quantity survey and on recent unit prices taken from bid abstracts for similar work items.
- Component 2 — Coagulation and Sedimentation System. The mechanical equipment was priced from recent vendor's quotes obtained for current Bechtel wastewater reclamation projects.

  The pricing for the civil, plant tie-in, and piping systems was based on rough takeoff quantities, and unit prices from recent bid prices for similar work. Unit prices include contractor's overhead and profit. The building costs were based on price parameters per square foot of floor area. Electrical and instrumentation were taken as a percentage of mechanical equipment costs, such as 20 percent for electrical and 10 percent for instrumentation.
- Component 3 — Partial Desalination Treatment. The pricing was based in part on the preliminary cost estimate performed for the Colorado River Basin Salinity Control Project by the Bureau of Reclamation in 1976. Adjustments and additions were made considering differences in unit sizes, plant flows, and salinity levels, and overall equipment cost was escalated to 1977 prices and checked against recent vendor's quotes obtained for smaller current Bechtel reverse osmosis projects. Civil, structural, electrical, and instrumentation were estimated as for component 2, above.
- Components 5 and 7 — Main and Booster Pumping Stations. The pricing was based on the Consoer-Bechtel (1974b) estimate, which was made in 1973. Adjustments in costs were made to conform to the present design and then escalated to the 1977 price level.
- Component 6 — Conveyance Pipeline Between Main and Booster Pumping Stations. Pipe material costs were taken from current bid information for other Bechtel jobs. Typical labor crews and production rates for excavation backfill and pipe installation were assumed, using 1977 labor rates for the San Jose area. Allowances were made for other items such as clearing, material handling, and cleanup. Overall cost was checked against costs for recent Bechtel pipeline projects.
- Components 8 and 10 — Conveyance Pipelines from Booster Pump to Bolsa and Santa Clara Valley Areas. The basis of pricing for pipe, excavation, backfill, and pipe installation was similar to previously discussed conveyance systems, except no shoring is required. Instead, pricing was based on using conventional open trench excavation with sloped sides.

Table V-15

COST ESTIMATE SUMMARY ALL COMPONENTS

Component	Description	1977 Capital Cost ($1,000)	1977 Amortized Capital Cost ($1,000/yr)	1977 O + M Cost ($1,000/yr)	1977 Total Annual Cost ($1,000/yr)	1977 Cost Per 1,000 Gal ($)	1977 Cost Per Acre-Foot ($)	1990 Total Annual Cost ($1,000/yr)	1990 Cost Per 1,000 Gal ($)	1990 Cost Per Acre-Foot ($)
1	Reclaimed Water Flow Diversion	1,320	106	5	111	0.007	2.22	222	0.014	4.44
5	Main Pumping Station	5,330	430	590	1,020	0.063	20.42	2,040	0.125	40.83
6	Conveyance Pipeline Between Pumping Stations	41,935	3,380	209	3,589	0.220	71.84	7,178	0.441	143.67
7	Booster Pumping Station	4,720	380	566	946	0.058	18.93	1,892	0.116	37.87
8	Conveyance Pipeline to the Bolsa Area	26,645	2,148	130	2,278	0.140	45.60	4,556	0.280	91.19
9	Bolsa Area Distribution System	15,810	1,274	71	1,345	0.083	26.92	2,690	0.165	53.84
2	Coagulation and Sedimentation Treatment	19,905	1,604	1,075	2,679	0.164	53.62	5,358	0.329	107.24
3	Partial Desalination Treatment	62,410	5,030	2,363	7,393	0.454	147.98	14,786	0.908	295.95
4	Carbon Adsorption Reverse Osmosis Treatment	84,440	6,806	2,200	9,006	0.553	180.26	18,012	1.106	360.52
10	Conveyance Pipeline to South Santa Clara Valley	15,940	1,285	80	1,365	0.084	27.32	2,730	0.168	54.64
11	South Santa Clara Valley Distribution System	9,360	754	35	789	0.048	15.79	1,578	0.097	31.58

- Components 9 and 11 – Bolsa and Santa Clara Distribution Systems. Pricing was based on a quantity takeoff for the pipe distribution system and pipe appurtenances. The basis of pricing for excavation backfill and pipe installation is as previously stated for Components 8 and 10.

- Component 4 – Carbon Adsorption and Reverse Osmosis Treatment. Pricing for carbon adsorption was based on a curve published by Culp, Wesner, and Culp (1974), escalated to 1977. The cost of additional reverse osmosis capacity was estimated by factoring up the estimated cost of the partial desalination treatment system (Component 3).

Engineering Construction Management Contingency

Allowances were made for these items; the percentages vary for each of the components as noted in the summaries.

Escalation

The escalation was based on a rate of 6-1/2 percent per annum. The escalation cost was computed from 1977 to the anticipated midpoint of expenditure date in the fourth quarter of 1988.

Schedule

For the purposes of cost estimating only, it was assumed that the engineering for this project would begin in June 1987 and would be completed in June 1988. Construction was assumed to start in April 1988 and to be completed in December 1990.

Operation and Maintenance

Annual operation and maintenance costs were developed for each of the components. Labor costs were derived from a study of operations at a number of wastewater and water reclamation plants in California. Power costs were calculated based on $0.02 per kW-hr, assuming that electricity would be priced for agricultural users. (If the power were priced for commercial users, it could be as high as $0.37 per kW-hr.) Material costs are based on vendor quotes for previous projects.

Major Exclusions

The following items have been specifically excluded from the estimate:

- Land, land rights, and right-of-way
- Interest during construction
- Owner's costs (administration, insurance, etc.)
- User's connection costs, sprinkling and spreading costs, drainage costs, and other costs associated with farm improvements

Assumptions

- Open trench excavation will be done with side slope for the conveyance line from the booster pump to the irrigation area.
- No rock excavation for the conveyance lines will be necessary
- All rights-of-way will be available to the contractor for the construction of the major conveyance lines and distribution system.
- Sheet pile shoring will be employed during construction of the conveyance line between the main reclaimed water pump and the booster pumping station.

V.3.6 BLENDING ALTERNATIVES

It is possible to produce an irrigation water of optimal or acceptable water quality by blending an unacceptable reclaimed water with a high quality water. This avoids the need of desalination treatment, although the Case B treatment required under Title 22 is still needed (coagulation and sedimentation in addition to existing waste treatment). Any blending scheme in the study area would require that potable water be diverted from its present use, thus creating additional demand that must be met with blended water. In order to reclaim 50,000 acre-feet of wastewater by 1:1 blending, 50,000 acre-feet must be diverted from its current market and blended, creating 100,000 acre-feet of blended water. One-half of this blended water is sent to the irrigational reclaimed water market in the Santa Clara Valley and/or Bolsa area, and one-half is returned to the current market of the potable water. Thus, blending alternatives require a source of potable water, an additional market for reclaimed water, and conveyance (pumping and piping) facilities to physically accomplish the blending and distribution of the water.

Blended Water Quality

As in the case of treatment alternatives, there are too many blending alternatives to cover in this study. Representative examples are discussed here.

There are three main possible sources of potable quality water for blending. In general, groundwater supplies in the study area have TDS levels too high for economical blending. Water supplied through the San Felipe Project and water supplied through the South Bay Aqueduct are both of good quality (TDS of about 250 mg/l) for blending, and Hetch Hetchy water is of excellent quality (TDS of about 50 mg/l).

Several blending ratios were investigated, ranging from 1 to 3 parts potable water to 1 part reclaimed water, and it was found that production of an optimal blend required a high blend ratio, limiting the feasibility of this alternative. The blending ratio can be lowered, however, by addition of gypsum ($CaSO_4$) to the water to adjust the SAR, or by acidification to reduce both bicarbonates and the SAR. It was found that a 1 to 1 blend ratio could be used with Hetch Hetchy water and Case B water if gypsum were added, and that a 1 to 1 ratio could be used with Hetch Hetchy, San Felipe, or South Bay Aqueduct water if acid addition was employed. The water qualities produced under these alternative conditions are listed in Table V-16. It is assumed that the mineral contents of the San Felipe and South Bay Aqueduct waters are similar.

Table V-16

WATER QUALITY OF ALTERNATIVE BLENDED WATERS

Parameter	Case B_1 (1)	Case B_2 (2)	Case B_3 (3)
TDS (mg/l)	644	450	550
Conductivity (μmho/cm)	1,000	750	900
SAR (adj.)	4.3	5.2	5.4
Sodium, mg/l (meq/l)	85 (3.8)	85 (3.8)	100 (4.3)
Chloride, mg/l (meq/l)	100 (2.9)	100 (2.9)	125 (3.6)
Calcium, mg/l (meq/l)	80 (4.0)	35 (1.7)	50 (2.4)
Magnesium, mg/l (meq/l)	7 (0.6)	7 (0.6)	7 (0.6)
Sulfate, mg/l (meq/l)	180 (3.8)	100 (2.1)	150 (3.0)
Bicarbonate, mg/l (meq/l)	130 (2.1)	90 (1.5)	90 (1.5)

Notes:

(1) 1:1 blend with Hetch Hetchy water, gypsum added.
(2) 1:1 blend with Hetch Hetchy water, acid added.
(3) 1:1 blend with South Bay Aqueduct or San Felipe water, acid added.

Blended Water Markets

In order to divert 50,000 acre-feet/year of blending water, the present committed markets for this water must also be supplied. Since Hetch Hetchy water is used mainly as a potable municipal supply, blended reclaimed water cannot be substituted for it directly. However, South Bay Aqueduct or San Felipe water could be diverted to supply the portion of the market supplied by a Hetch Hetchy blending source. Since some of this South Bay Aqueduct or San Felipe water is used (or is intended to be used) for agricultural irrigation, blended water could then be used to supply the present irrigation market in addition to the selected reclaimed water market.

If San Felipe or South Bay Aqueduct water were used directly for blending, blended water could be similarly allocated to the present irrigation markets for these waters. In general, while the possible ways of allocating various waters in the study area for blending are numerous, they all involve diverting potable agricultural irrigation water away from a market that can then be supplied with non-potable blended water. There are two markets that can be reallocated in this manner: one is in south Santa Clara Valley and the other is in San Benito County south and east of Hollister. The south Santa Clara Valley market is supplied with potable water by the Santa Clara Valley Water District from a number of sources and overlaps the area in the Santa Clara Valley to be served with reclaimed wastewater without blending. The San Benito County market is to be supplied with potable water by the San Felipe Division. While other markets may be available in the future (e.g., blended water may be used for groundwater recharge through percolation), the two potable agriculture irrigation water markets identified above are appropriate candidates for blended water. Accordingly, the market for blended water will consist of one of the two 50,000 acre-foot reclaimed water markets identified in Section V.3.1, combined with one of the two potable irrigation water markets identified above.

Blended Water Distribution

The configuration of the physical facilities required for a blending scheme depends on the location of the potable water source and the locations of the blended water markets and, therefore, is conceptual in nature in this section. Of the available water sources, both the Hetch Hetchy and South Bay Aqueduct supplies can be considered as located together at the north end of the service areas. Aqueducts carrying these supplies cross the proposed reclaimed water conveyance pipeline route south of the SJ/SC WPCP. Blending can be accomplished by pumping water from the potable water aqueduct into the reclaimed water pipeline at the intersection location. Conveyance to the market area would require enlarging the conveyance line south of the blending point to handle 100,000 acre-feet/year. If the Hetch Hetchy or the South Bay Aqueducts were the potable water source, the market for blended water would most likely be in the Santa Clara Valley, so the distribution system layout would be similar to the reclaimed water distribution system designed for the south Santa Clara Valley. The only changes would be due to the doubling of pipe and pump capacities.

If the San Felipe Project supplied the potable water, the Bolsa area would most likely be part of the blended water market. Reclaimed water would be conveyed through the pipeline to the Pajaro River (described in Section V.3.4) to supply the Bolsa area. From the end of this pipeline, a line would be built to link up with the closest San Felipe distribution line (Figure V-1), probably just north-east of the Bolsa area at the end of the Pacheco tunnel. A facility would be built at this point to blend the two water supplies and pump the blended water into a conveyance and distribution system covering the market in San Benito County south of Hollister as well as in the Bolsa area, or possibly one covering the Bolsa area and that part of Santa Clara Valley that may be supplied by San Felipe.

This conveyance and distribution system would parallel the separate systems to be built for San Felipe water. The systems must remain separate, since the San Felipe water is to be used partly for a potable supply, while blended water is not acceptable for such supply. From the conceptual point of view of this study, the systems to distribute to either San Benito or Santa Clara Counties would be similar enough to be equated in terms of probable piping and pumping costs. Thus, if San Felipe is chosen as the source for blending water, the required physical facilities for a blending scheme would include the previously described reclaimed water conveyance line to the Pajaro River, an additional conveyance to the blending site, a blending structure and pumping station, and a conveyance and distribution system covering the agricultural market and part of the planned San Felipe service area.

Blending System Alternatives

Two alternative blending systems can be developed from the above discussion for cost-estimating purposes: a northern alternative and a southern alternative. These are not the only alternatives, but are presented here as representative. The northern alternative would utilize Hetch Hetchy or South Bay Aqueduct water and could result in a water quality similar to any in Table V-9.

The northern alternative would require Case B treatment, a main reclaimed water pumping station, as designed above, and a short segment of 66-inch diameter convergence line to an intersection with a potable water supply aqueduct. In addition, this alternative would require a potable water lift pumping station and a blended conveyance and distribution system to the Santa Clara Valley and or the Bolsa area similar in alignment to but twice the capacity of the one designed above in Section V.3.4.

The southern alternative blending system would utilize San Felipe as a potable water source and produce a blended water quality similar to Case B_3 in Table V-9. This alternative would require Case B treatment and conveyance to the Pajaro River, as described in Section V.3.3. In addition, the southern alternative would require conveyance piping to the San Felipe distribution system, a blending and pumping facility, and a conveyance and distribution system to the market in the Santa Clara Valley and/or the Bolsa area and part of the San Felipe service area.

An approximate estimate of the cost for a representative blending alternative was generated as follows. It was assumed that San Felipe water will be the easiest water to allocate for blending from an institutional point of view, since this supply has not yet been constructed, while the South Bay Aqueduct and Hetch Hetchy supplies are already being used. Accordingly, the southern alternative was selected for this estimate. It was assumed further that the blending facility will be located near the outlet of the Pacheco tunnel, north of the Bolsa area and that the blended water will be marketed in the Santa Clara Valley (discussions of blended water in the Santa Clara Valley are given in Section V.3.2, Table V-25) or the Bolsa area and in a portion of the projected San Felipe service area roughly the size of the Bolsa area. This blending facility will be close enough to the distribution system pipelines described in Section V.2.4 to be tied in at negligible additional cost. Distribution was assumed to be mainly by gravity, with no additional pumping cost.

The cost of this system (Case B_3) is approximately equal to the cost of Case B treatment and conveyance to the Santa Clara Valley or the Bolsa area ($213.00/acre-foot, 1977 dollars), plus double the cost of the distribution system ($27/acre-foot), plus the cost of San Felipe water (unknown), for a total cost of at least $267.00/acre-foot of reclaimed water (see Table V-24).

Definition by policy makers of the source agency for water for blending and the marketing agency for blended water are required before the costs for blending alternatives can be refined.

V.3.7 ALTERNATING SUPPLY ALTERNATIVES

In addition to blending schemes, several other alternatives are available for mitigating the effects of poor reclaimed water quality on agriculture. Those farmers who have good groundwater supplies could irrigate on some days with reclaimed water and on others with groundwater. Periodic prolonged irrigation with groundwater could be used to leach salts from the reclaimed water out of the root zone. The main difficulty with this alternative is that it presents management and policing problems. Presently, agricultural water charges are based on estimates of water usage computed from evapotranspiration for certain cropping patterns plus leaching requirements. Such a system would have to be changed to include monitoring of pumping power usage and piped water flows. Instituting a systematic leaching program would require increased knowledge and daily concern on the part of the farmers regarding irrigation water and soil chemistry. Consequently, a large-scale alternating reclaimed water/clean water system dependent on the practice of leaching would be difficult to implement.

The principle of alternating supplies between reclaimed water and groundwater can be used to handle peak flows more economically. A reclaimed water supply providing acceptable water quality can be sized to handle less than the peak demand in a particular market (i.e., 80 percent of the peak) if the local groundwater supplies can be depended on to handle peak demand. In this way, reclaimed water can be used to alleviate groundwater overdraft conditions in some market areas, while economizing on reclaimed water system peak flow capacity and pipe sizes. Such a system would require a more expensive management component than the systems iesigned in this study. Analysis of the tradeoffs between increased flow measurement and system management costs on one hand, and increased pipe costs on the other, cannot be made until the managing agency is identified and its user charge policies defined. An alternating supply scheme intended to reduce peak flows would affect only the size of water reclamation facilities, not the level of treatment.

V.3.8 SUMMARY

From an engineering point of view, it is feasible but very expensive to reclaim SBDA wastewater for agricultural irrigation.

Section V.3 presented conceptual designs for reclaimed water conveyance and distribution systems serving two possible markets in the study area, one in south Santa Clara Valley and one in the Bolsa area of San Benito County. The costs associated with each of these systems are listed in Table V-15 and summarized later in the section (Table V-23).

Section V.3 also presented conceptual designs for four levels of reclaimed water treatment, ranging from no additional treatment to removal of practically all measurable pollutants. Case A treatment (no additional treatment) is not feasible due to difficulties in crop management and to probable changes in cropping patterns and is not considered further in this study. Case B treatment (coagulation and sedimentation) would meet legal public health requirements and therefore is feasible. However, it is expected that there would be significant adverse impact on agricultural production of certain sensitive crops due to use of Case B water. Case C treatment would meet legal requirements and would avoid adverse impacts on agriculture at typical levels of management. It represents a feasible but more expensive alternative to Case B. Case D treatment would exceed all public health and agricultural water quality criteria, but no real benefit would be derived from this excess. Since Case D treatment would be far more expensive than Case C, it is not considered cost-effective. Figure V-12 shows a graphical representation of the relationship between level of treatment and estimated cost.

It would be possible to produce an irrigation water of good quality (almost indistinguishable from Case C) by blending Case B water with a better quality water from another source. The cost for such a system would fall between the Case B and Case C costs due to increased pipeline and blending facility costs, assuming reclamation of the same quality of wastewater in all cases. The potential institutional constraints on a blending plan could be significant in that clean water presently allocated to particular users must be reallocated to blending and replaced by blended water. Accordingly, such a plan may not be feasible for implementation without the aid of several agencies. However, if reclaimed water could be used to replace a part of the San Felipe, South Bay Aqueduct, or Hetch Hetchy water allocations, then this constraint on the use of blended water would be substantially reduced.

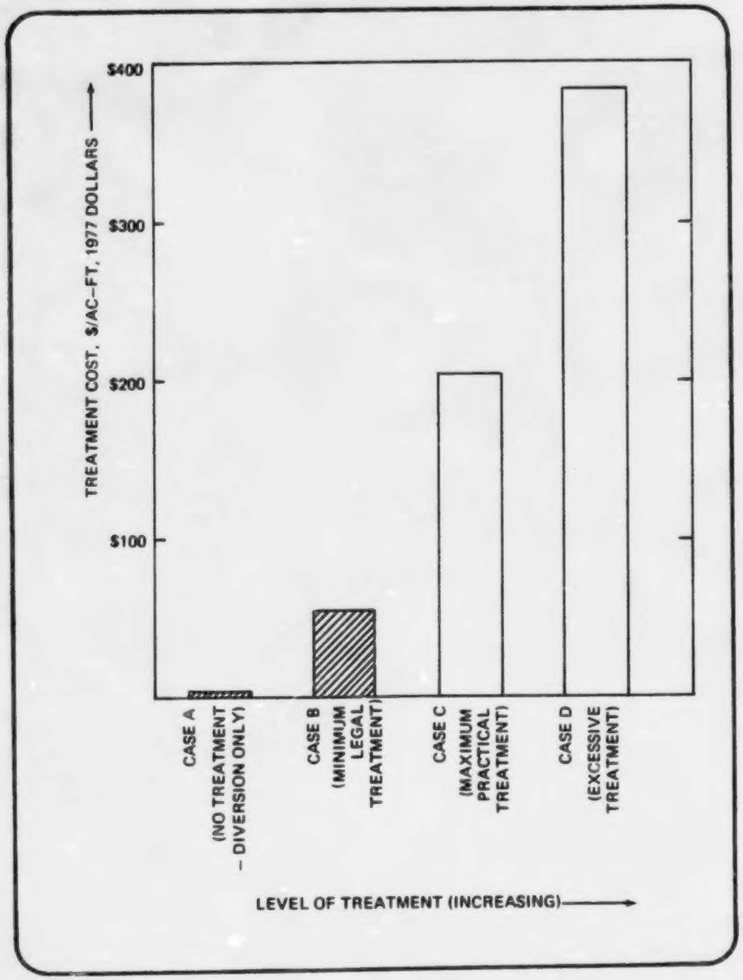


Figure V-12
EFFECT OF TREATMENT LEVEL ON WATER COST

V.4

AGRICULTURAL IMPACTS

This section discusses the possible effects of irrigation in the Santa Clara Valley and Bolsa areas of the study area, using wastewater from various treatment schemes presented in Section V.3. These treatment schemes do not include all possible combinations of treatment which would provide wastewater suitable for agricultural irrigation. However, for purposes of impact assessment, the number of systems was restricted to seven and divided into two groups on the basis of similarity of effluent qualities.

Each of the seven treatment schemes was analysed for potential impacts on agriculture in the Santa Clara County portion of the study area. Brief discussions of the applicability of these schemes to irrigation in the Bolsa area were also presented, but because data on agricultural use in the Bolsa area are limited, this latter analysis is less detailed and serves to identify areas for further study.

V.4.1 IMPACT OF CASES A AND B IN THE SANTA CLARA COUNTY PORTION OF THE STUDY AREA

Water quality characteristics for treatment Cases A and B would be essentially the same (Tables V-17 and V-18). The two schemes differ in the treatment methodology as follows:

- Case A. The effluent from the SJ/SC AWTF, now under construction, would be diverted and distributed, as is, for irrigation. Case A, as described in Section V.3, does not meet the treatment requirements of Title 22 for irrigation of unprocessed food crops.

- Case B. In addition to the treatment provided by SJ/SC WPCP and AWTF, a minimum of treatment, as required by Title 22 for irrigation of food crops, is employed to make SJ/SC effluent acceptable. The effluent is subjected to pH adjustment and chemical coagulation and sedimentation, as described in Section V.3.

Table V-17

PREDICTED COMPOSITION OF CASE A TREATMENT SCHEME WASTEWATER

Major Constituents	Concentration		
	Normal	Maximum	Minimum
pH	7.5	8.0	7.0
Total Dissolved Solids (ppm)	850	1,000	733
Electrical Conductivity (μmhos/cm)	1,400	1,600	940
Calcium (meq/l) – Ca	3.0	3.5	1.1
Magnesium (meq/l) – Mg	1.0	2.17	0.58
Sodium (meq/l) – Na	7.39	7.56	7.0
Potassium (meq/l) – K	0.28	0.43	0.28
Sulfates (meq/l) – SO_4	2.54	2.54	2.41
Chlorides (meq/l) – Cl	5.65	7.34	5.33
Carbonates (meq/l) – CO_3	-	-	-
Bicarbonates (meq/l) – HCO_3	4.1	4.91	3.27
Boron (ppm) – B	0.75	0.9	0.7
Sodium Absorption Ratio (adjusted)	10.45	-	-
Trace Metals (ppm)			
Aluminum	0.5	5.4	1.4
Arsenic	0.001	0.05	0.0001
Beryllium	ND(1)	ND	ND
Cadmium	0.001	0.002	ND
Cobalt	0.02	0.032	0.005
Chromium	0.05	0.11	0.01
Fluoride	0.8	1.0	0.5
Iron	0.25	0.25	0.22
Lithium	ND	ND	ND
Lead	0.015	0.02	0.0065
Magnesium	0.015	0.2	0.09
Nickel	0.03	0.061	0.005
Zinc	0.1	1.3	0.045
Molybdenum	0.03	0.05	-
Selenium	ND	ND	ND
Vanadium	ND	ND	ND

(1) ND = No Data: it is expected that all levels will meet criteria set for trace metals in waters used continuously on all soils (*National Academy of Science, 1972)*

Table V-18

PREDICTED COMPOSITION OF CASE B TREATMENT SCHEME WASTEWATER

Major Constituents(1)	Concentration Normal
pH	7.0
Total Dissolved Solids (ppm)	850
Electrical Conductivity (μmhos/cm)	1,400
Calcium (meq/l)	3.0
Magnesium (meq/l)	1.0
Sodium (meq/l)	7.39
Potassium (meq/l)	0.28
Sulfates (meq/l)	4.16
Chlorides (meq/l)	5.65
Carbonates (meq/l)	-
Bicarbonates (meq/l)	2.5
Boron (ppm)	0.75
Sodium Absorption Ratio, adjusted	9.41

Note:

(1) Trace metals and health regulation criteria are the same as in Case A, Table V-17.

Since the water quality of the two treatment schemes is similar, the effects on agricultural production will be similar and are discussed below for both cases. However, since Case A does not comply with the treatment requirements of the State of California Department of Health (1975) for general irrigation of food crops, it will not be considered further as a viable reclamation scheme.

Salinity Effects

As can be seen in Tables V-3, V-17, and V-18, Case A and B waters would have higher total dissolved solids (TDS) and electrical conductivity (EC) than the present groundwater supply in Santa Clara County, indicating that they are more saline than the groundwater.

Soils irrigated with saline water must have good drainage so that the downward movement of salts is not impeded. In general, irrigation with a higher salinity water requires more careful management, more work, and more water than irrigation with a good to excellent (low salinity) water. Management practices that could reduce potential salinity problems include application of extra water for leaching, selection of tolerant crops, changing irrigation methods, irrigating more frequently, or improving drainage.

Salinity levels in the soil that result from irrigating with a certain water vary with soil permeability and management practices. U.S. Department of Agriculture Handbook 60 (1954) states: "It was found ... that the electrical conductivity of the saturation extract (often) ranges from 2 to 10 times ... the conductivity of the irrigation water." Under optimum conditions, conductivity of the soil extract may be as little as 1.5 times that of the irrigation water.

Since Case A and B wastewaters are relatively high in sodium (high adjusted SAR), they would be expected to affect the permeability of soils by accelerating salt buildup. While farmers do have alternative management schemes to cope with this potential for salt buildup, in calculating the resulting yield losses for this study, it was assumed that electrical conductivity will be two to three-fold (2.5 average) higher in the saturation extract than in the wastewater. This may be a "worst case" estimate; pilot studies are needed to determine the actual effects on soils in the Santa Clara Valley.

Individual crops tolerate salty conditions to widely different degrees. In general, as a group, orchards are the most salt sensitive. Vegetables are slightly more salt tolerant than orchards. Field crops are the most salt tolerant. Salt tolerance of crops correlates with the minimum tolerated salt content of the soil saturation extract. This is normally measured and reported as the electrical conductivity of the extract (ECe).

Table V-19 shows the crops of the study area and the salinity levels (ECe) at which certain yield declines might be expected to occur. It should be noted that these expected losses in yield may not necessarily occur; however, if soil salinity values exceed the listed values, certain problems or yield losses will occur if adequate management practices are not adopted to correct, delay, or prevent the problem.

The elevated salt content of the Case A and B wastewater could affect many crops in the Santa Clara County area. Yield losses that could result from salinity are shown in Table V-20, assuming the yield decrements in Table V-19.

Strawberry, bushberry, mushroom, and flower and vegetable seed producing areas are not shown on the table; they are highly salt sensitive crops and any small increase in salinity would result in a high loss in gross income, essentially eliminating them as viable crops for the area should reclaimed water of Case A or B quality be used. Fruit and nuts are the next most salt sensitive crops grown in this area. Wastewater irrigation based on the study assumptions could cause more than 30 percent decline in orchard crop yields, or an income loss of $260 per acre. This represents $4.4 million loss over the 17,000-acre orchard area.

Vegetable crop decline would be approximately 18 percent, or a gross income loss of $300 per acre to the farmers. Assuming a 7,800-acre vegetable crop area, $2.3 million would be lost from the gross agricultural return of this area. Among vegetable crops which occupy 100 acres or more, beans, garlic, and peppers would be most affected. Least effect would occur to tomatoes, which are fairly salt tolerant among vegetables.

Field crops would not be affected significantly by salinity. Only alfalfa would suffer a small yield loss.

Effects of High Sodium Concentrations

Case A and B wastewaters are higher in sodium (Na) than the groundwater in Santa Clara County (Tables V-3, V-17, and V-18). The adjusted sodium absorption ratios are also higher for Cases A and B than for groundwater.

Table V-19

DECREMENT TO BE EXPECTED FOR CERTAIN CROP YIELDS DUE TO INCREASED SALINITY IN SOIL (FAO, 1976)

	Average ECe of Root Zone Soil in mmhos/cm which can be expected to result in a yield reduction of:				
Crops	0%	10%	25%	50%	Maximum
Apricots	1.6	2.0	2.6	3.7	6.0
Cherries	1.5	2.1	2.9	4.3	7.0
Grapes	1.5	2.5	4.1	6.7	12.0
Pears	1.7	2.3	3.3	4.8	8.0
Prunes	1.5	2.1	2.9	4.3	7.0
Walnuts	1.7	2.3	3.3	4.8	8.0
Strawberries	1.0	1.3	1.8	2.5	4.0
Vegetables					
Beans, Snap	1.0	1.5	2.3	3.6	6.5
Broccoli	2.8	3.9	5.5	8.2	13.5
Cabbage	1.8	2.8	4.4	7.0	12.0
Cucumber	2.5	3.3	4.4	6.3	10.0
Corn	1.7	2.5	3.8	5.9	10.0
Garlic	1.2	1.8	2.8	4.3	7.5
Lettuce, Head	1.3	2.1	3.2	5.2	9.0
Onions	1.2	1.8	2.8	4.3	7.5
Peppers, Bell	1.5	2.2	3.3	5.1	8.5
Spinach	2.0	3.3	5.3	8.6	15.0
Squash	2.5	3.3	4.4	6.3	10.0
Tomatoes, Fresh	2.5	3.5	5.0	7.6	12.5
Field					
Alfalfa	2.0	3.4	5.4	8.8	15.5
Irr. Pastures	6.0	7.4	9.5	13.0	20.0
Sugar Beets	7.0	8.7	11.0	15.0	24.0

The adjusted SAR indicates the sodium and bicarbonate concentration of the water in proportion to other constituents. It is calculated by using the following formula:

$$\text{adj. SAR} = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}} \left[1 + (8.4 - pHc)\right]$$

where pHc is a theoretical calculated pH of the irrigation water in contact with lime and in equilibrium with soil CO_2 (FAO, 1976).

Waters with elevated adjusted SAR are expected to affect the clay fraction of the soil and alter the soil structure. Permeability is normally reduced in soils that are irrigated with high adjusted SAR waters. Under such conditions, many more problems develop that are associated with poor drainage conditions. Reclamation of these soils is difficult and expensive, but changes in water and soil management practices can be adopted to prevent or correct the possible permeability problems.

Projected quality for Case A wastewater indicates that it will have 10.45 adjusted SAR (Table V-17), while Case B will have a 9.41 adjusted SAR (Table V-18). This may cause increasing problems in soils which contain illite-vermiculite and severe problems with montmorillonite clays (FAO, 1976). Least affected will be kaolinite clays (FAO, 1976).

Soils containing montmorillonite clays are common in agricultural soils. In the Santa Clara Valley, out of 70 soil types, the majority (62) contain this clay type in excess of 18 percent of the clay fraction. Prolonged use of Case A or B wastewater undoubtedly would create serious problems on some of these soils.

High adjusted SAR waters occasionally can be effectively treated. For example, the use of gypsum in treatment reduces the adjusted SAR. This treatment increases the total dissolved salt level in the water, which is undesirable for Santa Clara Valley agriculture.

Table V-20

EFFECT OF INCREASED SALINITY ON AGRICULTURAL PRODUCTIVITY AND GROSS INCOME/YEAR

Crop	Acres	Annual Gross Income ($1,000)	Yields at Salinity Levels			Gross Income(4) ($1,000)	Loss of(5) Income ($1,000)	Loss of Income(6) ($/acre)
			(1)	(2)	(3)			
Orchards								
Apricots	2,419	3,527	0.76	0.45	0.6	2,116	583	1,411
Cherries	721	1,284	0.76	0.45	0.6	770	712	514
Grapes	1,834	1,251	0.9	0.52	0.71	888	197	363
Pears	1,474	1,360	0.85	0.62	0.73	966	267	394
Prunes	7,342	3,928	0.8	0.55	0.67	2,632	174	1,296
Walnuts	3,104	943	0.85	0.6	0.72	679	85	264
Miscellaneous Orchards	390	600	0.85	0.5	0.67	402	507	198
Total	17,284	12,893	0.82	0.518	0.65	8,453	260	4,440
Vegetables								
Anise	10	16	0.7	0.5	0.6	10	600	6
Beans, Snap	335	566	0.7	0.45	0.57	396	508	170
Broccoli	50	36	0.1	0.88	0.94	34	40	2
Cabbage	70	51	0.95	0.55	0.7	36	272	15
Cauliflower	55	53	0.8	0.65	0.72	40	236	13
Chinese Vegetables	660	1,188	0.8	0.65	0.72	855	504	333
Corn	240	214	0.9	0.7	0.8	171	179	43
Cucumber	440	739	0.98	0.8	0.89	658	184	81
Endive	40	43	0.8	0.65	0.72	31	300	12
Garlic	500	993	0.78	0.52	0.65	645	696	348
Lettuce, Head	425	527	0.8	0.7	0.75	395	310	132
Lettuce, Leaf	390	391	0.8	0.7	0.75	293	251	98
Lettuce, Romaine	90	94	0.8	0.7	0.75	70	266	24
Mustard	50	52	0.95	0.8	0.87	45	140	7
Onions	305	1,378	0.78	0.52	0.65	895	1,583	483
Peppers, Bell	360	520	0.8	0.65	0.73	369	419	151
Peppers, Chili	315	759	0.8	0.65	0.73	530	701	221
Spinach	80	134	0.98	0.8	0.89	119	187	15
Squash	105	133	0.98	0.8	0.89	118	142	15
Tomatoes, Fresh	85	373	0.1	0.85	0.93	347	305	26
Tomatoes, Processed	2,500	3,422	0.1	0.85	0.93	3,182	96	240
Tomatoes, Cherry	70	538	0.1	0.85	0.93	500	542	38
Miscellaneous Vegetables	700	800	0.85	0.7	0.77	616	263	184
Total	7,875	13,020	0.876	0.7	0.79	10,363	300	2,657
Field								
Alfalfa	230	72	0.98	0.85	0.91	65	30	7
Irrigated Pastures	700	105	1.0	1.0	1.0	105	-	0
Sugar Beets	1,120	972	1.0	1.0	1.0	972	-	0
Total	2,050	1,149			0.996	1,142	30	7
Grand Total	27,209	27,062			0.74	19,958		7,104

(1) Assumed that $EC_w \times 2 = EC_e$.

(2) Assumed that $EC_w \times 3 = EC_e$.

(3) Arithmetical average of (1) and (2).

(4) Calculated using Salinity Level (3).

(5) These values are average losses per acre and, accordingly, are not additive.

(6) Assumes maximum losses will be sustained for salinity level (3).

The benefit of reduced adjusted SAR must be balanced against the potentially increased total dissolved salt level in order to determine whether or not treatment with gypsum is desirable for use of reclaimed wastewater for irrigation.

Specific Ion Toxicity

Sodium, chloride, and bicarbonate ions will be present in higher than desirable concentrations in the Case A and B wastewaters. The projected concentrations and the corresponding guideline levels are shown for these ions in Table V-21.

Table V-21

EFFECTS OF SPECIFIC IONS ON SENSITIVE CROPS (FAO, 1976)

	Projected(1) Concentration, in meq/l	Concentration in meq/l that will result in		
		No Problem	Increasing Problem	Severe Problem
Sodium (ADJ. Ion SAR)	9.4	3	3-9	9
Chloride (Cl^-)	5.6	4	4-10	10
Bicarbonate (HCO_3^-)	2.5 - 4.1	1.5	1.5 - 8.5	8.5

Note:
(1) Tables V-17 and V-18

Sodium and chloride only affect tree crops in the Santa Clara Valley. If the water is used for overhead sprinkler irrigation, leaf burns could be caused by levels of sodium or chloride over 3 meq/l. However, tree crops of the area would probably be eliminated by salinity from reclaimed water in both Cases A and B before any sodium problem could develop.

The bicarbonate concentration is also excessive; water with this concentration may cause white deposits on leaves or fruit if crops are sprinkler irrigated. Bicarbonate also affects soil permeability, but this effect is included in the adjusted SAR evaluation.

The projected normal and maximum boron concentrations in the wastewater are 0.75 and 0.9 ppm, respectively. No adverse effects of boron to crops are expected. In the Santa Clara Valley area, boron sensitive crops include apricots, cherries, grapes, pears, prunes, beans, and walnuts. However, these crops would be eliminated by the salinity of the water before boron problems could develop.

Summary of Effects on Agriculture of Cases A and B

Should wastewater of the projected quality be applied for irrigation of crops in Santa Clara County, agricultural practices in the study area would be expected to change. Farmers would have to grow crops that would tolerate the conditions created by this water, or, on some land, abandon farming. Some of the effects which could result from this irrigation practice are:

(1) Bearing young fruit tree stands growing in this area were valued at $1,237 to $2,645 per acre. A grape stand was valued at $885 per acre (*University of California Agricultural Extension Service Publication, 1968*). If no other condition prevailed, salinity or alkalinity could force the farmers to improve water management, or be prepared to suffer reduced yields or to pull the trees and plant other crops. In either case, the loss in tree stands could be as much as $25 million in the study area, assuming a $1,500 per acre tree stand value and 17,000-acre orchard area. The loss would be less if some orchards were not pulled and replaced; orchard owners could probably tolerate up to a ten percent loss in yield without pulling trees (Dr. R.S. Ayres, personal communication, October 21, 1977).

(2) Many vegetable crops could not be grown in the area. It is impossible to predict which crops would replace them. Tomatoes and sugar beets are relatively salt tolerant; however, they are grown under contract and an increase may affect market availability for these commodities.

(3) Farmers in the Santa Clara Valley area usually grow two to three crops per farm. For these crops, they have the facilities and specialized machinery necessary for profitable operation. Change from the present crops would result in a loss of these capital assets and would require new expenditures. As a general rule, capital investment for equipment constitutes a large part of farming cost (25 to 30%). While the numerical losses cannot be estimated at this time to many farmers they would undoubtedly be high.

(4) Orchard crops could decline in importance in the study area. Eventually, this could cause the loss of 41,000 tons of mixed fruits and 2,000 to 3,000 tons of walnuts per year now grown in the study area. Vegetable crop production would decline by about 17,000 tons per year. Present crops, when no longer economically feasible to grow, would be replaced by other more salt tolerant crops. Yields of these crops would compensate to some extent, as yet undetermined, for the lost fruits, walnuts, and vegetables.

V.4.2 IMPACT OF CASES C, D, B_1, B_2, AND B_3 IN THE SANTA CLARA COUNTY PORTION OF THE STUDY AREA

The treatment schemes for the five cases to be discussed in this section consist of:

- Case C. Case B water treated for reduction of salts by diversion of a side stream for desalinization to reduce TDS, and reblending with Case B water to produce 50,000 acre-feet of low TDS water.
- Case D. Full flow reverse osmosis downstream of Case B treatment, followed by activated carbon absorption, in accordance with draft guidelines for groundwater recharge proposed by California Department of Health (Appendix L).
- Case B_1. Treatment of Case B water with 0.6 ton of gypsum per acre-foot and blending 1:1 with 50,000 acre-feet of an excellent quality water (possible source: Hetch Hetchy aqueduct)
- Case B_2. Treatment of Case B water with sulfuric acid and blending 1:1 with Hetch Hetchy water
- Case B_3. Treatment as in Case B_2, but blending 1:1 with San Felipe Project or South Bay Aqueduct water, as described in Section V.3.

The composition of these waters is shown in Table V-22. Briefly, salinities would range from 150 to 1,000 μmhos/cm, with highest salt content in Cases B_1 and B_3. The adjusted SAR would be reduced to "safe" limits for all cases; the Na concentration would be lowest in Cases C and D; HCO3- would exceed the "safe" limits for sprinkling irrigation only in Case B_1; the Cl^- concentration would exceed "safe" limits only in Case B_3; and NO_3-N would be slightly higher in all cases than the recommended limits for sensitive crops.

In general, these waters are of excellent quality for irrigation. Salinity even from waters B_1 and B_3 would cause little or no problem on well-drained soils and under good management. For this study, it was assumed that conductivity would increase 1.5 times from the diluted wastewater to the soil saturation extract. (Actual changes in conductivity can only be determined from pilot studies.) Calculations indicate that, among the Santa Clara Valley crops considered for wastewater irrigation, only beans, onions, garlic, and lettuce would be slightly affected. In beans, yield loss would be about 10 percent, in garlic and onions 5 percent, and in lettuce less than 5 percent. Gross income loss in the study area would be approximately $190,000 per year. This is a negligible amount when compared to the

Table V-22

PREDICTED COMPOSITION OF CASES C, D, B_1, B_2, AND B_3(1) TREATMENT SCHEME WASTEWATERS

Major Constituents	C	D	B_1	B_2	B_3
Total Dissolved Solids (ppm)	400	85	644	450	550
Electrical Conductivity (μmhos/cm)	600	150	1000	750	900
Calcium (meq/l)	1.25	0.15	4.0	1.7	2.4
Magnesium (meq/l)	0.42	0.04	0.6	0.6	0.6
Sodium (meq/l)	3.47	0.78	3.8	3.8	4.3
Potassium (meq/l)	0.1	0.01	0.3	0.3	0.3
Sulfates (meq/l)	1.67	0.41	3.8	2.1	3.0
Chlorides (meq/l)	2.28	0.57	2.9	2.9	3.6
Carbonates (meq/l)	-	-	-	-	-
Bicarbonates (meq/l)	1.15	0.33	2.1	1.5	1.5
Boron (ppm)	0.5	0.1	0.4	0.3	0.3
Nitrate Nitrogen NO_3-N (ppm)	10	2	11	11	11
Ammonia Nitrogen NH_3-N (ppm)	1	0.2	1	1	1
Phosphate PO_4-P (ppm)	2.0	0.5	2.5	2.5	2.5
Sodium Absorption Ratio, adjusted	4.5	<0.1	4.3	5.2	5.4

Note:

(1) Trace metal criteria will be the same as Case A (Table V-17). Health regulation criteria will be met for sprinkler irrigation of food crops.

\$27 million total gross income per year from the study area. It appears that yield losses would cause little or no problem, even to the farmer who grows these salt sensitive crops.

Sodium, chlorides, and bicarbonates in some cases would be slightly higher than the safe limit for sprinkler irrigation of sensitive crops. However, the excess would be slight, and it is anticipated that few, if any, problems would develop. The waters would be non-alkaline and would not affect permeability of the soils.

V.4.3 IMPACT OF IRRIGATION WITH RECLAIMED WATER IN THE BOLSA AREA

As can be seen by comparison of water quality in Tables V-3, V-17, V-18, and V-22, all treatment schemes (except Cases A and B) could produce water of better quality (lower TDS, EC, Na, Cl, and HCO_3) than present highly variable groundwater supplies in the Bolsa area. Therefore, wastewaters from Cases C, D, B_1, B_2, and B_3 are acceptable for irrigation as in the Santa Clara County portion of the study area (Section V.4.2).

The area considered for wastewater irrigation with Cases C, D, B_1, B_2, or B_3 in the Bolsa area is outlined in Figure V-2. It encompasses approximately 17,500 acres in the northwest corner of San Benito County. Three major land-use categories are also shown in Figure V-2. Irrigated land occupies approximately 13,500 acres, dry farm land 2,000 acres, and rangeland 2,000 acres. The rest of the cultivated land of the county is expected to receive irrigation water from the San Felipe Project, according to USBR, DWR, and SCVWD plans (USBR, 1973).

Irrigated land provides the highest income per acre among the three land-use categories (Table V-5). The irrigated acreage is limited at the present time in the Bolsa area by the lack of drainage and usable quality water. All of the soils would be suitable for irrigation if drainage and usable quality water could be provided. Construction of a drain system in the Bolsa area should include the installation of drain pipes (tile) in the field and closed pipes to the point where the drain water can be discharged. A drainage system was recently installed on a smaller area (280 acres) elsewhere in San Benito County, at a cost of approximately $180 per acre, (San Benito County Agricultural Commission, personal communication, 1977). After drainage has been constructed, irrigation with a reclaimed water supply would result in considerable benefits to farmers and to agriculture.

The largest of these benefits would result when the presently dry farmed land and rangeland (4,000 acres) are brought under irrigation. Bringing this area, where the productivity is now $32 per acre, under irrigation would increase productivity to $930 per acre ($930 is the present estimated productivity of the already irrigated land). This increase of approximately $900 per acre would represent $3,600,000 new gross income to the area's agriculture. This newly irrigated land would produce approximately 55,000 tons of mixed agriculture products instead of the present 3,000 tons.

Additional benefits would occur in the areas where irrigation water currently is of poor quality. In these areas, farmers could grow higher income crops or improve yields with the better quality wastewaters. However, at present, the size of this benefit cannot be estimated.

The disposal of collected drain water would create a difficult problem. The Pajaro River is the outlet for the entire Bolsa area, and discharge from drains into the river would further degrade its already poor quality. Downstream water uses and environmental considerations may prevent such practice.

The U.S. Department of Agriculture Soil Conservation Service is presently studying the drainage conditions and developing plans for an agricultural drain and disposal of drainage water in the area, should agricultural expansion into the Bolsa area occur.

V.5

ECONOMIC IMPACT ANALYSIS

This section presents estimates of capital and operating costs for conceptual level designs to reclaim 50,000 acre-feet per year of SBDA wastewater. Unit costs per acre-foot for the components of the alternative designs are shown in Table V-15 of Section V.3. Table V-11 shows how the components are assembled into treatment Cases A, B, C, and D. Section V.3 presents the cost analysis for Case B_3 as well. The unit costs are discussed at three different levels; (1) the real economic cost, (2) the subsidized cost of the water to the Santa Clara Valley Water District for distribution in south Santa Clara County or to another agency for distribution to the Bolsa area, and (3) the cost of the water for agricultural use, assuming SCVWD distribution of the water. These costs are then compared at the district level to the other principal alternative source of water to agriculture — San Felipe. The economic impact on the agricultural sector, based on the use of the reclaimed water for irrigation, is also estimated.

V.5.1 CONCEPTUAL LEVEL COSTS

Table V-23 presents the capital, annual operating, and energy costs required to treat and convey the different qualities of reclaimed wastewater into either south Santa Clara County or the Bolsa area in San Benito County. Costs for Case A water quality are presented in the table even though water at that quality is unacceptable for unrestricted irrigation uses.

Table V-24 presents the costs per acre-foot of the treated and conveyed wastewater in real economic costs (i.e., frequently termed as the cost to the nation). The costs shown do not include any form of subsidy or other federal and state programs of financial assistance for water development. As shown in the table, the unsubsidized reclaimed wastewater treated to meet California Department of Public Health quality requirements for unrestricted irrigation uses and to meet requirements for acceptable water quality for irrigation is prohibitively expensive (i.e., $360 per acre-foot for Case C in south Santa Clara County and $390 for the Bolsa area).

Assuming that the wastewater reclamation capital costs for both the treatment and conveyance facilities qualify for 87.5 percent state/federal grant funding, the cost of the reclaimed water, assuming sale to the Santa Clara Valley Water District (SCVWD), becomes considerably less expensive than the real economic cost. Table V-25 presents the cost of the water to the SCVWD assuming 87.5 percent grant funding. However, when the price of San Felipe water is compared to the SCVWD price of $16.50 per acre-foot at the agricultural rate, the subsidized costs of reclaimed water to the SCVWD remain prohibitively expensive (Table V-25). In order to make this cost comparison with San Felipe water, it was necessary to make the assumption that the costs of distributing the water from the conveyance system to the farmer would be borne by the farmer (surface facilities) and would be approximately equal in cost to the farmer's pumping and well costs if San Felipe water were used for groundwater recharge.

Based on the SCVWD pricing policies, water is priced to the customer at a single rate, irrespective of whether the water is obtained through weather modification or locally conserved, imported, reclaimed, or desalinized sources. This "water pooling" concept considers all the SCVWD water to be mixed, and the district has a uniform basic water charge for raw water and a uniform charge for treated water. This basic water charge is separated into two rates, an agricultural rate and a non-agricultural, or municipal and industrial, rate. Accordingly, both expensive and inexpensive waters are pooled and charged out to the customers at a separate but uniform rate for either agricultural or municipal and industrial use.
Table V-26 presents the estimated cost of agricultural water in the south Santa Clara County area of benefit under the various reclaimed water alternatives as well as for San Felipe water under the district's anticipated pricing policy. The municipal and industrial rate would be four times the agricultural rate.

V.5.2 FEDERAL AND STATE PROGRAMS OF FINANCIAL ASSISTANCE FOR WATER DEVELOPMENT

The 1977 edition of the *California State Assembly Committee on Water, Handbook of Federal and State Programs of Financial Assistance for Water Development* briefly summarizes several federal and state aid programs that apply to wastewater reclamation. Of the various aid programs available, only two appear to be directly applicable to this project: (1) Public Law 84-984, Small Reclamation Projects Act of 1956, could provide a loan only for the conveyance facilities for reclaimed wastewater that meets public health water quality requirements, and (2) the State Water Quality Control Fund (State Financial Assistance for Water Pollution Control and Wastewater Reclamation, Water Code Section 13400 *et seq.)* of the State Water Resources Control Board could possibly provide partial funding in the form of a loan for the construction of this project.

Assuming that this project would qualify for 87.5 percent federal/state grant funding of the capital costs, the cost of the reclaimed wastewater to SCVWD is not competitive with San Felipe water, the latter being priced to the district at $16.50 per acre-foot for agricultural uses. The impact of the assumed 87.5 percent federal/state grant for capital costs on the ultimate unit cost per acre-foot of reclaimed SBDA wastewater is summarized in Table V-26. As shown in the table, even with 87.5 percent grant funding, the cost of acceptable quality reclaimed wastewater (e.g., Cases C, D, and B_3) to the farmer is prohibitively expensive. Accordingly, neither Public Law 984 nor Water Code Section 13400 funds, if available, could reduce the water cost to competitive levels.

V.5.3 ECONOMIC IMPACT ON AGRICULTURE

As discussed in previous sections of this report, the expected quality of reclaimed SBDA wastewater (Cases C, D, and B_3) will be superior to the quality of the present water in the Bolsa area of San Benito County

Table V-23

CAPITAL, ANNUAL OPERATION AND MAINTENANCE COSTS, AND ENERGY COSTS FOR THE FIVE CATEGORIES OF RECLAIMED WATER TREATED AND CONVEYED TO EITHER SOUTH SANTA CLARA OR BOLSA AREA
(1,000's of 1977 Dollars)

Water Case	Capital Costs		Annual Operation and Maintenance Costs(1)		Annual Energy Costs(2)	
	Santa Clara Valley	Bolsa	Santa Clara Valley	Bolsa	Santa Clara Valley	Bolsa
A	78,600	95,800	1,490	1,570	820	820
B	98,050	115,700	2,560	2,650	920	920
C	160,900	178,100	4,920	5,010	1,950	1,950
D	245,350	262,550	7,120	7,210	2,350	2,350
B_3(3)	N/A(4)	131,500	N/A	2,720	N/A	1,740

Notes:

(1) Annual Operation and Maintenance includes the energy costs shown in the next column.

(2) Electric power priced at $0.02 per kWh, a standard agricultural charge. Should the charge be adjusted to commercial rates ($0.37 per kWh), this cost would be significantly higher and would therefore constitute a larger percentage of project operation costs (PG&E 1977 rate schedules).

(3) Blended at a 1:1 ratio with San Felipe water; see Section V.3.6 for a description of this alternative.

(4) N/A means not an acceptable concept, because Santa Clara Valley would prefer to use groundwater rather than potentially inferior and more expensive blended water.

but not superior to the water currently used in the Santa Clara Valley (Tables V-9, V-22 for treatment schemes, Table V-3 for groundwater quality in both regions). Accordingly, there is no economic incentive to use reclaimed wastewater for agriculture in the Santa Clara Valley except in periods of extended drought.

Assuming that Case C, D, and B_3 quality water could be competitively priced to agriculture, the economic impact of using 50,000 acre-feet of wastewater on San Benito County would be quite favorable. Approximately 300 additional acres of orchard could be brought into production as well as an additional 1,900 acres of vegetables and 1,800 acres of field crops. The increase in annual revenues to agriculture attributable to this increased production would be approximately $3.5 million.

Under any circumstance, application of Case A or B water would have substantial adverse economic impacts on agricultural production. Rough order-of-magnitude

Table V-24

REAL ECONOMIC COSTS TO TREAT AND CONVEY RECLAIMED WASTEWATER TO EITHER THE SOUTH SANTA CLARA OR THE BOLSA AREA(1)

(1977 Dollars per acre-foot)

Water Case	Treatment Cost	Conveyance Cost		Total Cost	
		SCV	Bolsa	SCV	Bolsa
A	2.20	155.00	184.00	157.20	186.20
B	56.00	155.00	184.00	211.00	240.00
C	204.00	155.00	184.00	359.00	388.00
D	384.00	155.00	184.00	539.00	568.00
B_3	56.00	N/A(2)	211.00(3)	N/A	267.00(4)

Notes:

(1) Amortization and interest on the capital costs are based on 7 percent at 30 years.

(2) N/A means not an acceptable concept, because Santa Clara County would prefer to use groundwater rather than potentially inferior and more expensive blended water.

(3) Includes conveyance costs to the Bolsa area plus distribution costs for an expanded market area in Santa Clara and San Benito Counties.

(4) Includes Case B treatment costs but excludes the per acre-foot real costs for San Felipe blending water, since these costs are not available to the public at this time.

Table V-25

UNIT COST OF RECLAIMED WASTEWATER TO THE SANTA CLARA VALLEY WATER DISTRICT ASSUMING 87.5 PERCENT STATE/FEDERAL GRANT FUNDING OF THE CAPITAL COSTS

(1977 Dollars)

Water Case	Cost per Acre-Foot to SCVWD	
	Conveyed to South Santa Clara Valley	Conveyed to the Bolsa Area
A	45.50	51.00
B	71.00	76.00
C	131.00	136.00
D	192.00	197.00
B_3	N/A(1)	97.50(2)

Notes:

(1) N/A means not an acceptable concept, because Santa Clara County would prefer to use groundwater rather than potentially inferior and more expensive blended water.

(2) Includes $16.50 per acre-foot for San Filipe blending water.

estimates of a worst case condition would be the complete elimination of orchards and vegetables with an attendant loss in agricultural revenue of approximately $29 million per year in Santa Clara County and approximately $13 million per year in San Benito County (Section V.4.1).

Table V-26

COST OF SCVWD WATER TO AGRICULTURAL USERS IN SOUTH SANTA CLARA COUNTY FOR THE RECLAIMED SBDA WASTEWATER OPTIONS ESTIMATED FOR THE YEAR 1985-1986

(1977 Dollars)

Water Case	Cost per Acre-Foot to Agricultural (1) Users Assuming Full Subsidy
San Felipe(3)	5.00(2)
A	15.00(4)
B	23.00(4)
C	43.00(4)
D	62.00(4)
B_3	17.00(4)

Notes:

(1) The agricultural rate shown here is estimated at approximately 25 percent of the municipal and industrial rate for the south county according to SCVWD pricing policies, i.e., the municipal and industrial rate is four times the agricultural rate.

(2) Source: The Santa Clara Valley Water District, 1977. Estimates by SCVWD.

(3) Based on current SCVWD plans to meet supplemental water needs in South Santa Clara County with water from the USBR's San Felipe Project.

(4) Estimates by SCVWD based on the costs shown in Table V-23.

V.6

OTHER IMPACTS

In addition to the potential for agricultural and economic impacts (both beneficial and adverse), the use of reclaimed water has the potential for impact on other aspects of the environment. These impacts can result from construction of treatment and transport facilities as well as from operation of the facilities and actual use of the wastewater.

In Sections III and IV.2, the effects of construction of a disposal system and discharge of varying quantities of treated effluent to San Francisco Bay are discussed. The use of a portion of effluent for reclamation will not materially change the impacts of the disposal system, regardless of the disposal alternative chosen. Therefore, in this section, summary discussions of potentially adverse impacts on water quality, soil quality, public health, land use, and energy supplies in the market area are presented. Because of the conceptual nature of this study, these effects cannot be quantified, and, in many instances, site-specific factors vary enough to affect significantly the size of the impact. For this reason, pilot studies should be performed to allow for analysis of these impacts if a reclamation system is implemented.

V.6.1 POTENTIAL FOR CONTAMINATION OF GROUND AND SURFACE WATER SUPPLIES

One of the primary concerns in any wastewater disposal or reuse program is the protection of potable water supplies. The statutes of the State of California are designed to protect these water supplies by providing for best practicable waste treatment (EPA, 1975). For this reason, all wastewater to be reused must meet minimum discharge requirements if any of that wastewater is expected to reach surface or groundwater supplies which are now, or may be, used for drinking water. The requirements for wastewater reclamation are described in the California Administrative Code, Title 22, Division 4 (Environmental Health), and enclosed in Appendix L. In addition, draft standards for groundwater recharge have been proposed by the state and are presently undergoing hearings around the state (Appendix L). The EPA has promulgated requirements for maximum groundwater contaminants resulting from ground application of wastewater (Appendix L).

The potential for contamination of the groundwater in Santa Clara and San Benito Counties cannot be quantified at this time. One of the three basic mechanisms of groundwater contamination is pollution after the pollutants have traversed the soil-vegetation matrix (EPA, 1977). Others are direct introduction of pollutants to the aquifer and alterations within and between aquifers; these latter two are not applicable to irrigation with reclaimed water. However, variations in soil types and permeability and the susceptibility of the groundwater basins to contamination could result in wide variations of contamination potential throughout the study area. These variations can only be determined through pilot studies. The following problems and mitigating measures have been identified in this study:

- Since the use of wastewater for irrigation does not constitute direct groundwater recharge, and since the quantities applied in irrigation are significantly less than those used in recharge, the potential for buildup of materials harmful to human health in groundwater is not expected to be great under normal agricultural practice (State Department of Health, personal communication, May 1977).

- In those areas where closed groundwater basins may be susceptible to long-term buildup of toxic materials under normal agricultural practices, augmentation to Case D level treatment — approximately equivalent to State Draft Standards for recharge — may be necessary. Pilot studies in the study area would be necessary to determine if such potential exists; the results of these pilot studies compared to present studies on the Whittier Narrows groundwater recharge program and the Monterey County agricultural studies (State Department of Health, personal communication, May 1977) may indicate whether or not groundwater contamination is a potential problem.

Contamination of surface waters should not result from agricultural use of reclaimed water. However, in the Bolsa area, where drainage may be required (Section V.4), highly saline waters will be discharged from the fields until the soils are leached and salt buildup is reduced. In addition, other "pollutants" such as nutrients may be contained in this drainage. Since the Pajaro River is used downstream for agricultural purposes (RWQCB-3, 1975), discharge of agricultural drainage might not be acceptable. Conceptual design and feasibility studies of an acceptable agricultural drain would be necessary before the Bolsa area could implement irrigation with reclaimed water or any other imported water.

V.6.2 LONG-TERM BUILDUP OF SALTS IN SOIL

As discussed in Section V.4, the potential for long-term problems due to the quality of water applied is greater for waters with high TDS, high EC, high alkalinity, high adjusted SAR, or high HCO_3 concentrations. Use of wastewaters treated to Cases C, D, B_1, B_2, or B_3 should not result in as much or as rapid a salt buildup in the Santa Clara Valley. Water management techniques now in use are usually adequate for use of these better quality waters.

Should a lower quality water (Case B) be selected for use, management tools for salinity control might include (RWQCB-3, 1975):

- Efficient application of water, reducing the leaching to a minimum but still preventing salt accumulation in the root zones of the soil

- Periodic leaching of soils as necessary for salt control using good quality water or excess water

- Installation of artificial drains (or tile systems), as suggested for the Bolsa area (Section V.4), where high water tables need control, and establishment of acceptable disposal areas for the drainage

- Management of fertilizer application and soil amendments to achieve acceptable production but with minimum inputs of salts from other sources

The rate of salt accumulation is influenced by many factors, primarily management, but also including soil type and water quality (Section V.4). Since management ability of the farm operators as well as the soils are variable within the study area, the potential for salt buildup can be expected to vary as well. Detailed analyses of the rate of salinization are not possible without pilot studies.

V.6.3 PUBLIC HEALTH CONCERNS

Due to the associated public health problems, the use of untreated sewage on vegetables or fruits where contamination is likely and when grown for human consumption has long been prohibited in this country (California Department of Health, 1971). Treatment requirements as set forth in Title 22, Division 4 of the California Administrative Code (Appendix L) as amended (SWRCB and Department of Health, 1977) takes this prohibition into consideration. Article 2 specifies that reclaimed water, in order to be acceptable for crops intended for human use, must be adequately disinfected, oxidized, coagulated, and filtered with a median number of coliforms not to exceed 2.2 per 100 milliliters. In this study, all treatment schemes excepting Case A meet these requirements, the general requirements of design specified in Article 8 of the same regulation, and the requirements for unlimited recreational use.

Since these regulations are directed toward the protection of the health of the consumer, no public health problems are anticipated from the use of any of the treatment schemes described in Section V.4 as acceptable from an agricultural point of view. Should some treatment failure occur, alternative reliability requirements as described in Article 10 of Title 22 should be sufficient to prevent exposure of farmers or farm workers to untreated or partially treated wastewater. The farmer should have an alternate supply of water available should such periods of upset occur during the growing season.

V.6.4 EFFECTS ON LAND USE AND WATER USE

The Santa Clara Valley Water District (1975) has identified a potential water shortage, based on population growth assuming a net annual immigration of 5,000 persons to the year 2020, no increases in per capita consumption, and decreases in outdoor-residential use. This water requirement in excess of present supplies also assumes average rainfall years. The conclusion of the SCVWD study was that the deficit requires an expanded water distribution study, importation of water from the San Felipe Project, and other conservation and water reclamation measures.

Should a reclaimed wastewater source be made available to the SCVWD, it could free an equal amount of higher quality water for more sensitive uses such as drinking water. In this fashion, the implementation of a reclamation/reuse project results in either a reallocation of potable water resources or a possible reduction of need (conservation) to draw on water reservoirs. It could, however, be a stimulus for continued population growth in the area. Such population growth could result in increased urbanization in the area at the expense of agricultural uses. Since the reclaimed water supply proposed in this survey is not adaptable to municipal and industrial use without substantial alterations to the treatment system (requiring upgrading) and transport systems, any urban growth would, of necessity, be limited to the level that can be supplied by the increased higher quality water, or about a quarter of a million people for the 50,000 acre-feet (SCVWD, 1975). The exact rate of population growth attributable to an increased supply of potable water cannot be estimated, however, since any variation in demand for imported water supplies can affect the potential market for reclaimed water. For example, a reduction in the agricultural market through urbanization of the area will reduce the use of reclaimed water unless alternative markets can be identified and developed. This change in markets could, in effect, reduce the total available water over time, without affecting the supply of potable water.

As described in Sections V.2 and V.4, present agricultural trends in the study area include a loss of agricultural land to urbanization and a switch to specialty crops with a higher profit potential for the farmer. The use of reclaimed water is not likely to slow the urbanization trend and may limit the transition to specialty crops due to their sensitivity to lower quality water. In fact, with the higher cost of reclaimed water to the farmer, sale of land for development might even be accelerated, particularly in the areas of Santa Clara County that cannot compete with large-scale agriculture elsewhere in California.

V.6.5 ENERGY CONSUMPTION

Energy, in the form of electricity, is used in several aspects of the treatment schemes and in the pumping of the reclaimed water to the proposed market areas. This energy consumption, shown as dollar costs in Table V-23 for each treatment scheme, constitutes an increase of between 41×10^6 and 117.5×10^6 kWh per year over the energy consumed for the Basin Plan Alternative (Section III.5.4). Present energy consumption in the Santa Clara Valley study area for irrigation is approximately 11×10^6 kWh per year (assuming 150-foot well depth and 0.7 pump efficiency). In the study area in San Benito County, energy use is approximately 8.5×10^6 kWh per year.

Power consumption of 41 x 10^6 kWh is equivalent to approximately 25,500 barrels of crude oil, while 117.5 x 10^6 kWh is equivalent to approximately 73,000 barrels. This consumption ranges between 5 and 15 times the energy required to dispose of the treated wastewater of the entire SBDA system through a pipeline to Dumbarton Bridge in 1980. The same energy consumption would occur if each of the 1,193,400 residents of Santa Clara County burned two 150-watt light bulbs for 5 to 15 days a year.

V.6.6 OTHER EFFECTS

Construction and operation of a reclamation facility will have impacts on the environment similar to the effects expected from construction and operation of the Basin Plan Alternative. However, until exact locations of treatment facilities, pumping stations, and rights-of-way for pipelines can be established, these effects cannot be described quantitatively. The types of impacts expected will be:

- Clearing, grading, and site preparation. For the treatment facility, these effects will not be significant, since the facility likely will be at the existing SJ/SC treatment plant site. The impact of clearing, grading, and site preparation for pumping stations and the distribution system will depend on location, with more serious impacts occurring in areas with habitat types critical to rare species, in prime agricultural areas, or near streambeds where loss of vegetation and erosion could be significant. While the potential for significant impact along the right-of-way is greater than that for the other facilities due to the greater acreage affected, revegetation of the right-of-way after construction will serve to reduce the long-term adverse impacts. Other sources of impact during site preparation include dust and vehicle emissions, noise, alterations in traffic flow, interruption of access to the work areas, and aesthetic (or visual effects) of construction equipment. These effects are relatively minor and short-term, lasting only during the time that construction activity will be in any location. Mitigating measures suggested for these effects in Sections III.1.1 and III.3 are appropriate.

- Operation of treatment facility. Consumption of chemicals (varying with the treatment scheme) and energy are the main effects of the treatment facility operation. The facility will consume more material than the present treatment plant as well as more energy (discussed in Section V.6.5), and this consumption is reflected in the increased costs of treatment. Increased amounts of sludges may result, depending on treatment, and these sludges, if not economically recoverable, will require landfill space. Any waste streams from treatment will likely be mixed with the water pollution control plant effluent before discharge; degradation of the effluent should not exceed that predicted in Section VI from the mixing of Leslie Salt bittern with SBDA effluent.

- Operation of pumping stations. The visual effect and noise levels, as well as energy consumption, will constitute the major operational impact of pumping stations. The severity of the aesthetic and noise impacts can be reduced by location, by enclosure of the station, by landscaping, and by other actions to improve the appearance of the facility. Energy effects are discussed in Section V.6.5.

- Operation of the pipeline. Normal operation of the transport pipeline will have no impact, especially since the pipeline will be buried throughout its length. While the structure of the system might be vulnerable in the event of an earthquake, the effect of a spill of such highly treated water should not be significant. Shutoff valves and other safety precautions can be installed in order to prevent accumulation of spilled water which might result in pooling, erosion at the right-of-way, or other localized effects on topography.

"End-of-the-pipe" effects, consisting of the impact of the wastewater on soils, water quality, agriculture, and local economies, have been described elsewhere in this section.

Section VI

ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT BITTERN COMPANY THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

The Leslie Salt Company, as described in Sections II.1.2 and II.1.3, produces salt from approximately 35,000 acres of salt ponds around San Francisco Bay, 26,500 acres of which are found in the South Bay area. As a byproduct of the final stages of salt production, a liquor, or highly concentrated brine solution, is produced. This liquor, called bittern, has had, in the past, a significant commercial value as a source of magnesium, bromine, and gypsum salts (CDM,* 1972). In the early 1970's, the market for bittern diminished, and when Leslie Salt Company began to dispose of the bittern into Newark Slough, they were asked by the Regional Water Quality Control Board to investigate other means of bittern disposal.

For the past several years, the bittern has been stored in ponds near the Newark, California, salt plant. CDM (1972) analyses of this stored bittern indicated that as much as 201 million gallons of bittern are produced and stored per year. At this rate of production, Leslie Salt Company has had to convert productive salt ponds into bittern storage ponds, reducing production capacity. Consequently, Leslie Salt Company has considered several alternative bittern disposal methods.

Analysis of the impacts of South Bay Dischargers Authority wastewater on the water quality and biology of the South Bay (Sections I-IV) was made on the assumption that Leslie Salt Company would continue storing bittern (i.e., a zero-discharge mode). However, recent communications from the California Regional Water Quality Control Board (San Francisco Bay Region) to Leslie Salt Company and the South Bay Dischargers Authority indicate that the best alternative for Leslie Salt Company may be discharge of the bittern through the diffuser of the Basin Plan Alternative. The Basin Plan Alternative or any other disposal decision by SBDA would be essentially unaffected by a Leslie Salt Company decision to dispose of bittern through a diffuser north of the Dumbarton Bridge, but such a decision on the part of Leslie Salt Company must be predicated upon SBDA's acceptance of the alternative involving disposal north of the Dumbarton Bridge (i.e., Alternative 1, the Basin Plan Alternative). The environmental impact assessment presented in Section VI has been required by the Environmental Protection Agency to clarify the impacts of joint and individual bittern disposal alternatives in the event that SBDA accepts the Basin Plan Alternative.

---

*CDM Inc. is a consulting firm, a subsidiary of Camp, Dresser and McKee, consulting engineers.

VI.1

DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES

VI.1.1 DISPOSAL OF BITTERN

Leslie Salt Company commissioned CDM to investigate various alternative means of bittern disposal. In 1972, CDM issued a report describing the problems with discharging bittern to the Bay and a diffuser system, which, given certain discharge restrictions, would allow deepwater disposal through an existing cross-Bay pipe line. These restrictions included (1) disposal at the rate of 5.5 mgd during the six colder (and wetter) months, for two and one-half hours of each tidal cycle at the maximum flow of ebb tide, and (2) dilution of the otherwise toxic bittern.

CDM (1972) performed chemical analysis of the bittern (Table VI-1) and determined that undiluted bittern was highly toxic. A 96-hour bioassay determined that the tolerance limit median (TLm), or the concentration of a substance required to kill 50 percent of the test organisms (the threespine stickleback, *Gasterosteus aculeatus*), ranged from 1.4 to 2.0 percent of the bittern. In other words, a minimum dilution of 100:1 was required to maintain a 100-percent survival of test fishes over a 96-hour period. (It should be noted that the threespine stickleback, a small fish typically used for toxicity bioassays, has a wide tolerance to variation in salinity (Lagler et al., 1962). Therefore, survival rates of species with narrower tolerance ranges to salinity variation may be lower than 100 percent at a 100:1 dilution of bittern.)

In this 1972 analysis, a hydraulic model was used to show that only 130 square feet of Bay bottom would be exposed to bittern diluted between 100:1 and 200:1, for each diffuser port. The model used solutions mixed to the specific gravity of bittern (1.29) and Bay water (1.015 to 1.026) in order to simulate the mixing zone at different tidal velocities, jet angles, and jet velocities. This study was used as the basis for the analyses in Sections VI.1.3 and VI.3.2 of this EIR/EIS.

In 1975, after being informed that the California State Department of Fish and Game was concerned about the zone of toxicity around such a diffuser system, Leslie Salt Company was informed that an alternative means of disposal, which ensured a minimum 100:1 dilution prior to discharge to the Bay, should be investigated.

CDM (1975) issued an analysis of the use of wastewater as a primary diluent for the bittern. Alternative sources of diluent, discussed in Section VI.1.4, required additional foreclosure of productive salt ponds, which was not only determined to be an economic constraint to continued operation of the Leslie Salt facilities, but would also reduce the acreage of environmentally desirable ponds within the San Francisco Bay National Wildlife Refuse. Wastewater sources in the Bay Area included the South Bay Dischargers Authority, the East Bay Dischargers Authority, and the South Bayside system. The latter two systems could not guarantee sufficient outfall system capacity. In addition, constraints on Leslie Salt participation with East Bay Dischargers and South Bayside included:

- Insufficient wastewater quantity at South Bayside to guarantee 100:1 dilution
- Requirement to transport bittern to a point north of the proposed Hayward STP (EPA, 1975); since the operation of this or any other treatment plant along the disposal system would be upset by the addition of the toxic bittern. (EBDA treatment plants will be biological systems.)

Table VI-1

CHEMICAL ANALYSIS OF BAY WATER AND BITTERN(1)

	Bay Water(2)	Bittern 1:1(2)	Undiluted(3)
pH	8.1	7.8	7.05
Total Solids (ppm)	30,631	241,550	618,450
Total Volatile Solids (ppm)	5,488	86,600	332,580
Total Suspended Solids (ppm)	44	1,760	1,240
Total Dissolved Solids (ppm)	30,587	239,790	617,210
Alkalinity as $CaCO_3$ (ppm)	194	2,800	3,500
BOD (ppm)	1.2	198	240
COD (ppm)	225	6,350	8,000
Ammonia as N (ppm)	0.06	0.702	3.75
Kjeldahl Nitrogen Total (ppm)	1.10	32.610	38.80
Nitrate as N (ppm)	0.72	37.50	–
Phosphorus Total as P (ppm)	0.41	0.22	6.66
Chloride (ppm)	17,000	158,000	352,000
Cyanide (ppm)	<0.04	<0.04	<0.04
Fluoride (ppm)	1.21	74.90	75.0
Phenols (ppb)	<6	64.10	172
Sulfate as S (ppm)	2,400	21,000	20,600
Sulfide as S (ppm)	<2	<2	<2
TOC (ppm)	18.5	900	2,700
Aluminum (ppb)	200	2,500	2,800
Arsenic (ppb)	<10	40	60
Cadmium (ppb)	<20	<20	<20
Calcium (ppm)	380	450	50
Chromium (ppb)	<20	<20	<20
Iron (ppb)	20	6,500	75
Lead (ppb)	<20	<20	20
Mercury (ppb)	<1	<1	2
Sodium (ppm)	7,500	5,500	30,000
Titanium (ppb)	<20	<20	<20
Zinc (ppb)	30	190	80
Copper (ppb)	–	–	20
Nickel (ppb)	–	–	<20
Silver (ppb)	–	–	<20

Notes:
(1) All tests by Standard Methods, 13th Edition, except Hg, Ti by WQO.
(2) Samples collected February 16, 1972 (CDM, 1972).
(3) Samples collected December 5, 1975 (CDM, personal communication, 1975).

The quantity of wastewater, the size of the proposed disposal project, and the location of the diffuser made SBDA an economic and technically feasible source of diluent. The 1975 CDM analysis is the basis for discussions in Sections VI.1.2 and VI.3.1 of this EIR/EIS.

VI.1.2 LESLIE SALT BITTERN DISCHARGED VIA BASIN PLAN ALTERNATIVE

One source of water for dilution readily available to Leslie Salt Company is treated wastewater currently being discharged to San Francisco Bay. A number of discharger authorities and regional facility management plans have been established; these include the East Bay Dischargers Authority, the South Bay Dischargers Authority, the South Bayshore Authority, and others. In order for this wastewater to be an acceptable diluent for Leslie Salt Company bittern, the following conditions must be met:

- Sufficient quantities of water must be available to dilute the bittern. A 100:1 dilution ratio is the minimum level allowable for disposal.

- The Leslie Salt Company discharge to the wastewater outfall must be designed to minimize impact on treatment facilities, reclamation plans, and other wastewater management plans. Since the bittern cannot be effectively treated, discharge directly to the disposal outfall is the most favorable method.

- Participation of Leslie Salt Company in a discharger's outfall should be considered in outfall design and location.

In communication with the various discharger authorities on these issues, Leslie Salt and the Regional Water Quality Control Board determined that the best available source of wastewater as a diluent was the South Bay Dischargers Authority. To this end, CDM performed a study (1975) on the water quality impacts expected from discharge of bittern diluted with wastewater of a quality similar to that predicted in the South Bay Dischargers Authority 1972 feasibility study (Consoer-Bechtel, 1972). This report concluded that, using the effluent quality and quantity expected from the combined plants (then assumed to be the Union Sanitary District, San Jose/Santa Clara, Palo Alto, and San Mateo), toxicity requirements could be met. It should be noted that the South Bay Dischargers Authority now consists of San Jose/Santa Clara, Sunnyvale, and Palo Alto; wastewater quality and quantity vary from that predicted in the Consoer-Bechtel (1972) report.

For purposes of this study, an SBDA/Leslie Salt Company common discharge system was assumed to be as follows (Figure VI-1):

- The Leslie Salt bittern would be pumped to the SBDA pipeline via the existing 20-inch buried pipeline now crossing the Bay.
- The Leslie Salt pumping station would be located at an existing pumping station on the dike at Salt Pond No. 3, and the point of tie-in to the SBDA pipeline would be upstream of the diffuser near the Dumbarton Bridge.
- In order to protect against reverse flows, a check valve would be provided in the Leslie Salt pipeline along with a gate valve to permit repairs to the pumping station.
- In addition, flow metering would be required on the downstream side of the pumping station.

VI.1.3 LESLIE SALT BITTERN DISCHARGED THROUGH A SEPARATE DIFFUSER

Another source of diluent for the bittern is San Francisco Bay water. CDM (1972) proposed such a discharge system, designed to obtain maximum dilution benefit from Bay currents. Using a diffuser near the Dumbarton Bridge, bittern would be discharged during the six winter (wet) months of the year, for about two and one-half hours of each tidal cycle during maximum flow of ebb tide.

For purposes of their study, the CDM (1972) conceptual design for a 24-inch diameter diffuser was used. This diffuser, 625 feet long with one-inch diameter ports spaced on six-foot centers, would be connected to the existing 20-inch pipeline across the Bay. The existing pump on the east shore of the Bay would be replaced. Using design flows of 11.0 million gallons per day (5.5 mgd bittern diluted 1:1 with Bay water, limited to 6 months of the year and to 2.5 hours per tidal cycle as stated earlier) and design dilution of 100:1 before the plume hits the bottom of the Bay, the plume was calculated to extend approximately 3 meters horizontally and 1.7 meters vertically from the point of discharge, with a vertical thickness and horizontal thickness of about 0.5 meters and 1.8 meters, respectively (CDM, 1972). A bottom area of at least 130 square feet would be exposed to a dilution of between 100:1 and 200:1 for each exit port, for a total area of 0.3 acre (CDM, 1972). The location of this proposed disposal system is shown in Figure VI-2.

However in this EIR/EIS, the model analysis of this alternative assumes more conservative year-round flows at the rate of 0.55 million gallons per day of undiluted bittern, and design of a disposal system for these flows might differ significantly from the CDM 1972 design.

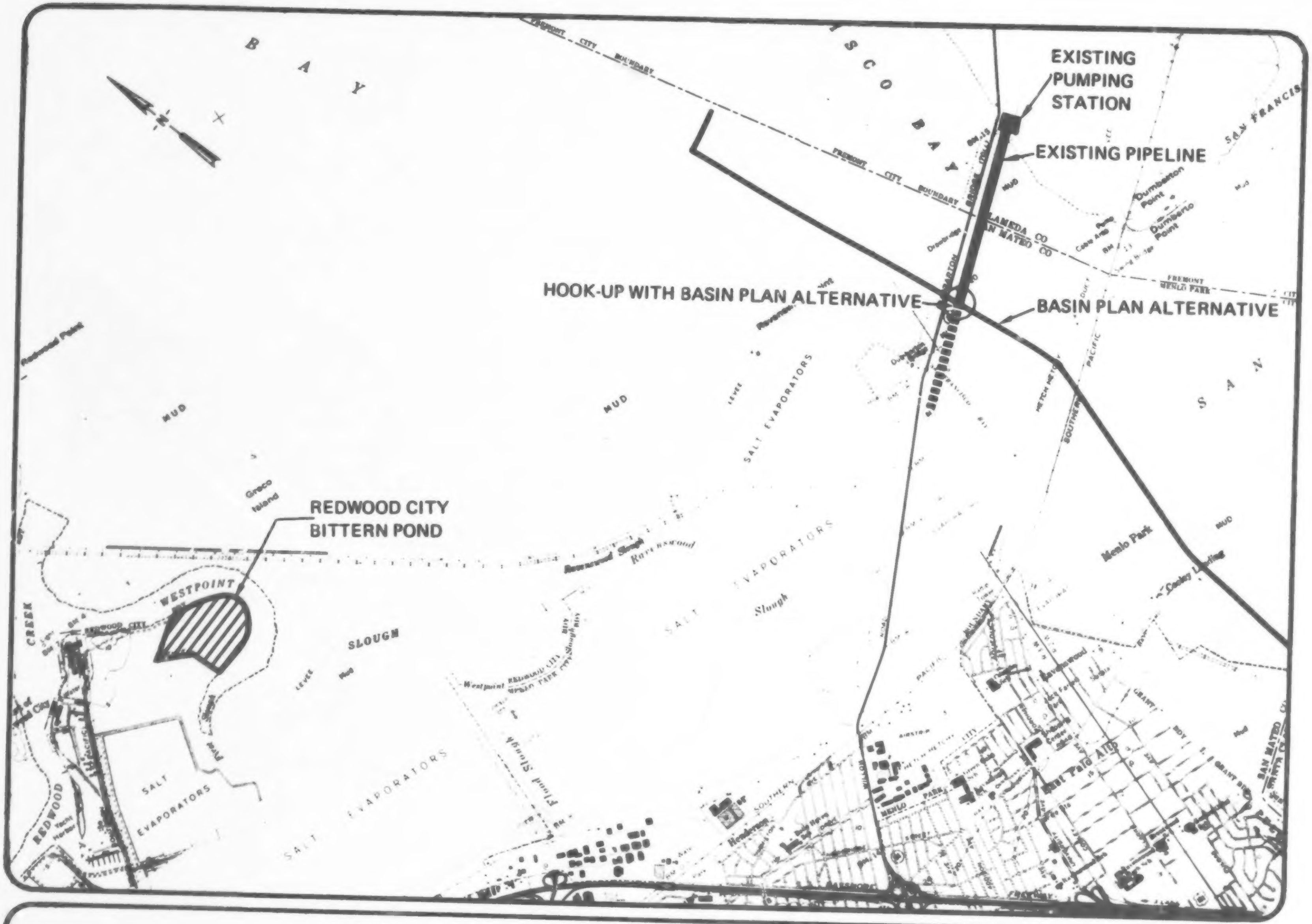
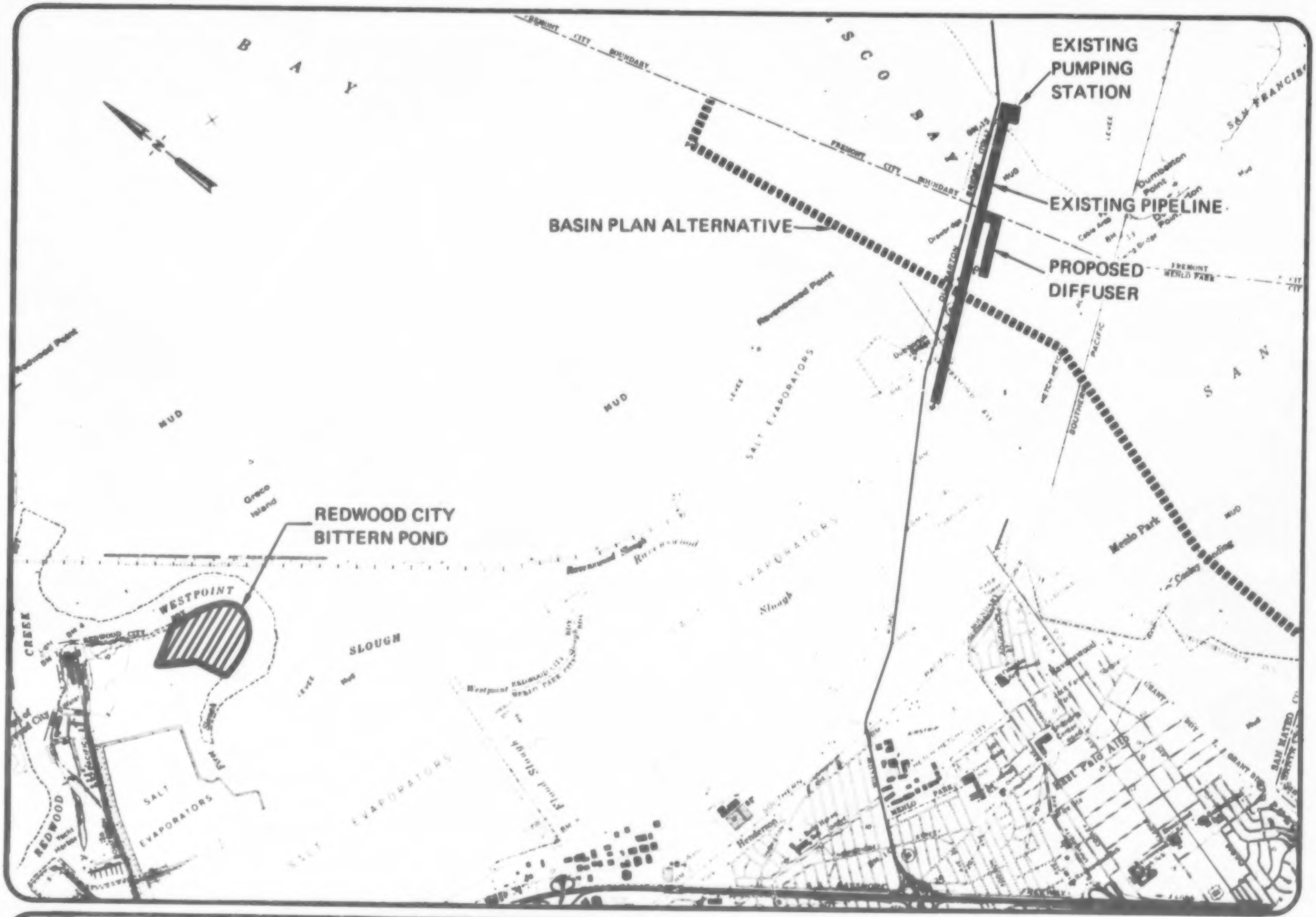

EXISTING PUMPING STATION
EXISTING PIPELINE
HOOK-UP WITH BASIN PLAN ALTERNATIVE
BASIN PLAN ALTERNATIVE
REDWOOD CITY BITTERN POND
BAY
SCO BAY
SAN FRANCIS
SAN
FREMONT CITY BOUNDARY
ALAMEDA CO
SAN MATEO CO
FREMONT
MENLO PARK
Dumbarton Point
Redwood Point
Greco Island
MUD
SALT EVAPORATORS
SLOUGH
WESTPOINT
Ravenswood Slough
Westpoint
Flood Slough
LEVEE
CREEK
REDWOOD
Yacht Harbor
SOUTHERN PACIFIC
HETCH HETCHY
Menlo Park
Cooley Landing
East Palo Alto
SAN MATEO

Figure VI-I
LESLIE SALT COMPANY BITTERN DISPOSAL SYSTEM—
DISCHARGE TO SBDA DIFFUSER


EXISTING
PUMPING
STATION
EXISTING PIPELINE
BASIN PLAN ALTERNATIVE
PROPOSED
DIFFUSER
REDWOOD CITY
BITTERN POND
B A Y
S C O B A Y
S A N
FREMONT CITY BOUNDARY
MUD
SALT EVAPORATORS
Greco Island
WESTPOINT
SLOUGH
CREEK
REDWOOD
Ravenswood Point
Menlo Park
East Palo Alto
Flood Slough
Dumbarton Point

SOURCE: CDM, 1972

Figure VI-2
LESLIE SALT COMPANY BITTERN DISPOSAL SYSTEM—
SPEARATE DIFFUSER

CONTENTS

Section Page

I DESCRIPTION OF BASIN PLAN AND ALTERNATIVES
I.1 DESCRIPTION OF ALTERNATIVES 1 1/D13
I.1.1 Introduction 1 1/D13
I.1.2 Background and Objectives 4 1/E5
I.1.3 Criteria for Evaluation of Alternatives 6 1/E9
I.1.4 Evaluation of Alternatives 6 1/E9
Alternative 2 — No Further Action 9 1/F1
Alternative 3 — Individual Outfalls to Nearest Deepwater 10 1/F3
Alternative 4 — Local Discharge with Upgraded Treatment 11 1/F5
Alternative 5 — Reclamation and Reuse of Treated Wastewater 13 1/F9
I.1.5 Alternative Alignments to Basin Plan Alternative 15 1/F13
I.2 THE BASIN PLAN ALTERNATIVE 19 1/G7
I.2.1 Location 19 1/G7
I.2.2 Facilities for the Basin Plan Alternative 21 1/G11
San Jose/Santa Clara Pumping Station 22 1/G13
Pipeline Segment — San Jose Santa Clara to Sunnyvale 22 1/G13
Sunnyvale Pumping Station 22 1/G13
Pipeline Segment — Sunnyvale to Palo Alto 24 2/B1
Palo Alto Pumping Station 24 2/B1
Pipeline Segment — Palo Alto to Discharge Point 24 2/B1
Diffuser 24 2/B1
I.2.3 Construction of the Basin Plan Alternative 25 2/B3
Construction Procedures on Land 25 2/B3
Construction Procedures in Water 26 2/B5
I.2.4 Operation of the Basin Plan Alternative 28 2/B9
I.3 APPROVALS REQUIRED 29 2/B11
II ENVIRONMENTAL DESCRIPTION
II.1 PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT) 31 2/C3
II.1.1 Physical Environment 31 2/C3
Topography 31 2/C3
Geology and Seismology 33 2/C7
Groundwater 33 2/C7
Soils 36 2/C13
Sediments 37 2/D1
Meteorology 39 2/D5
Air Quality 40 2/D7
- The Air Pollution Problem in the Bay Area 40 2/D7
— Emissions and Air Quality 40 2/D7
— Air Quality in the Bay Area 45 2/E3
— Air Impacts of Wastewater Disposal 45 2/E3
Hydrology 45 2/E3
— Tides and Currents 46 2/E5
— Circulation and Dispersion 47 2/E7
Water Quality 49 2/E11
— Temperature 51 2/F1
— Transparency 51 2/F1
— pH 51 2/F1
— Suspended Solids 51 2/F1
— Salinity 52 2/F3
— Dissolved Oxygen and Oxygen Demand 53 2/F5
— Nutrients 53 2/F5
— Chlorophyll 54 2/F7
— Coliform Bacteria 54 2/F7
— Oil and Grease 55 2/F9
— Toxicity 55 2/F9
— Heavy Metals 57 2/F13
Noise 57 2/F13
II.1.2 Biological Environment 58 2/G1
South Bay Habitats 58 2/G1
— Open Water 61 2/G7
— Tidal Mud Flats 64 2/G13
— Salt Marsh 68 3/B5
— Salt Ponds 71 3/B11
Dikes and Levees 74 3/C3
— Grasslands 75 3/C5
— Streams and Sloughs 75 3/C5
— Freshwater Marshes and Ponds 77 3/C9
Species of Special Concern 78 3/C11

II.1.3 Social, Economic, and Cultural Environment 83 3/D7
  Population and Demography 83 3/D7
  Recreational and Scientific Uses of the Area 87 3/E1
  Archaeological, Paleontological, Historical and Cultural Resources 88 3/E3
    — Archaeological Resources 88 3/E3
    — Paleontological Resources 89 3/E5
    — Historical and Cultural Resources 89 3/E5
  Visual and Aesthetic Setting 93 3/E13
  Economic Setting 98 3/F9
II.2 LAND USE
II.2.1 Present Land-Use Patterns 101 3/G1
  Existing Land Use 101 3/G1
    — Santa Clara County 101 3/G1
    — San Mateo County 104 3/G7
  Existing Public and Private Developments 104 3/G7
  Mineral Resources of the Baylands 112 4/B7
II.2.2 Projected Land-Use Patterns 112 4/B7
  Planned Public and Private Developments 112 4/B7
  Land-Use Plans and Planning Agencies 114 4/B11
  Interested Agencies 118 4/C5
    — Local 118 4/C5
    — Regional 118 4/C5
    — State 118 4/C5
    — Federal 119 4/C7
II.3 WATER USE
II.3.1 Existing and Proposed Wastewater Treatment Facilities 120 4/C9
  San Jose/Santa Clara Regional Water Pollution Control Plant 120 4/C9
  Sunnyvale Water Pollution Control Plant 120 4/C9
  Palo Alto Treatment Plant 121 4/C11
  Menlo Park Sanitary District Wastewater Treatment Plant 121 4/C11
  Redwood City Sanitary District — Redwood City Sewage Treatment Facility 121 4/C11
  Redwood City Sanitary District — Redwood Shores Plant 122 4/C13
  Belmont/San Carlos Joint Sewage Treatment Facility 122 4/C13
  Proposed Redwood Shores Subregional Plant 122 4/C13
  Union Sanitary District — Alvarado, Plant No. 3 122 4/C13
  Union Sanitary District — Newark, Plant No. 1 122 4/C13
  Union Sanitary District — Irvington, Plant No. 2 122 4/C13
II.3.2 Current and Projected Sources of Water 122 4/C13
II.3.3 Current Water Use and Projected Demand 123 4/D1
II.3.4 Current and Projected Water Quality 123 4/D1
III ENVIRONMENTAL IMPACTS
III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129 4/E1
III.1.1 Construction Impacts 129 4/E1
  Physical Environment 129 4/E1
    — Topography 129 4/E1
    — Air Quality 130 4/E3
    — Water Quality 131 4/E5
    — Sediment Quality 132 4/E7
    — Noise 132 4/E7
  Biological Environment 133 4/E9
    — Segment I — San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134 4/E11
    — Segment II — Sunnyvale Pumping Station to Palo Alto Treatment Plant 136 4/F1
    — Segment III — Palo Alto Treatment Plant to Discharge Point 138 4/F5
  Social, Economic, and Cultural Environment 140 4/F9
    — Recreational Uses of the Area 140 4/F9

— Archaeological, Paleontological, and Historical Resources 141 4/F11
— Visual and Aesthetic Setting 141 4/F11
— Economic Setting 141 4/F11
— Present Land-Use Patterns 143 4/G1
— Projected Land-Use Patterns 144 4/G3
III.1.2 Operation Impacts 144 4/G3
Physical Environment 144 4/G3
— Hydrology 144 4/G3
— Water Quality 144 4/G3
— Sediment Quality 148 4/G11
— Noise 150 5/A13
Biological Environment 152 5/B3
Social, Economic, and Cultural Environment 154 5/B7
— Recreational Uses of the Area 154 5/B7
— Visual and Aesthetic Setting 155 5/B9
— Present and Future Land-Use 155 5/B9
— Energy Consumption 155 5/B9
III.1.3 Economic Impact of the Basin Plan Alternative 155 5/B9
Introduction 155 5/B9
Study Assumptions and Methodology 155 5/B9
— Capital Costs 156 5/B11
— Operation and Maintenance Costs 158 5/C1
Computation of Allocation Factors 158 5/C1
User Charges to Discharger Groups 159 5/C3
— Residential Dischargers 159 5/C3
— Commercial Dischargers 159 5/C3
— Industrial Dischargers 159 5/C3
— Direct Impact on Industrial Dischargers 162 5/C9
Analysis of the Canned Fruit and Vegetable Industry 163 5/C11
— Industry Characteristics 163 5/C11
— Methodology 164 5/C13
— Conclusions of Analysis 165 5/D1
Conclusions 165 5/D1
III.1.4 Accident or Natural Catastrophe 166 5/D3
Flooding 166 5/D3
Earthquake 166 5/D3
Plant Upset 166 5/D3
Pumping Station Malfunction 166 5/D3
III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168 5/D7
III.2.1 Adverse Construction Effects 168 5/D7
Physical Environment 168 5/D7
Biological Environment 168 5/D7
Social, Economic, and Cultural Environment 168 5/D7
III.2.2 Adverse Operational Effects 169 5/D9
Physical Environment 169 5/D9
Biological Environment 169 5/D9
Social, Economic, and Cultural Environment 169 5/D9
III.3 MITIGATION MEASURES 170 5/D11
III.3.1 Mitigation of Construction Impacts 170 5/D11
Proposed Measures 170 5/D11
Potential Measures 172 5/E2
III.3.2 Mitigation of Operation Impacts 173 5/E3
Proposed Measures 173 5/E3
Potential Measures 173 5/E3
III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174 5/E5
III.4.1 Short-Term Uses of Man's Environment 174 5/E5
III.4.2 Maintenance and Enhancement of Long-Term Productivity 174 5/E5
III.4.3 Need for the Project 175 5/E7
III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176 5/E9
III.5.1 Permanent Changes in Land Features and Land Use 177 5/E11
III.5.2 Biological Systems 177 5/E11
III.5.3 Assimilative Capacity of the Bay 177 5/E11
III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177 5/E11
III.6 GROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178 5/E13

IV ALTERNATIVES TO THE BASIN PLAN

IV.1 INTRODUCTION 181 5/F7
IV.2 ALTERNATIVES 182 5/F9

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183 5/F11
Participation by Other Entities 184 5/F13
Alternative Alignments 184 5/F13
Result of Screening 185 5/G1
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188 5/G7
Result of Screening 190 5/G11
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190 5/G11
Result of Screening 191 5/G13
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193 6/B1
Result of Screening 195 6/B5
IV.2.5 Alternative 5 — Reclamation and Reuse 195 6/B5
Reclamation in Santa Clara County 197 6/B9
Smaller Reuse Markets in the Service Area 199 6/B13
Markets Outside the Service Area 201 6/C3
Result of Screening 202 6/C5
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202 6/C5
Result of Screening 203 6/C7
IV.2.7 Alternative 7 - Discharge to the Ocean 203 6/C7
Result of Screening 204 6/C9
IV.2.8 Alternative 8 — Land Disposal 204 6/C9
Result of Screening 205 6/C11
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206 6/C13
Result of Screening 206 6/C13
V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION
V.1 INTRODUCTION 207 6/D3
V.2 STUDY AREA 209 6/D7
V.2.1 Location of Study Area 210 6/D9
V.2.2 Water Demand and Supply 210 6/D9
V.2.3 Quality of Groundwater Supplies 213 6/E1
V.2.4 Quality of Soils 213 6/E1
V.2.5 Agricultural Land Use 215 6/E5
V.3 CONCEPTUAL DESIGN 217 6/E9
V.3.1 Potential Markets 218 6/E11
V.3.2 Reclaimed Water Quality 219 6/E13
Source Control 221 6/F3
Level of Reclaimed Water Treatment 222 6/F5
V.3.3 Treatment Conceptual Designs 224 6/F9
Reclaimed Water Flow Diversion 226 6/F13
Coagulation and Sedimentation with Alkalinity Control 226 6/F13
Alkalinity Control 230 6/G7
Partial Desalination Treatment 232 6/G11
V.3.4 Conveyance and Distribution Conceptual Designs 233 6/G13
Pumping 234 7/A13
Conveyance Pipeline 235 7/B1
Santa Clara Valley Distribution System 236 7/B3
Bolsa Distribution System 236 7/B3
User Connections 236 7/B3
V.3.5 Cost Estimates 242 7/C1
Basis of Estimate 242 7/C1
Engineering Construction Management Contingency 244 7/C5
Escalation 244 7/C5
Schedule 244 7/C5
Operation and Maintenance 244 7/C5
Major Exclusions 244 7/C5
Assumptions 244 7/C5
V.3.6 Blending Alternatives 244 7/C5
Blended Water Quality 245 7/C7
Blended Water Markets 245 7/C7
Blended Water Distribution 246 7/C9
Blending System Alternatives 247 7/C11
V.3.7 Alternating Supply Alternatives 247 7/C11
V.3.8 Summary 248 7/C13
V.4 AGRICULTURAL IMPACTS 249 7/D1
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250 7/D3
Salinity Effects 251 7/D5
Effects of High Sodium Concentrations 253 7/D9

Specific Ion Toxicity 255 7/D13
Summary of Effects on Agriculture of Cases A and B 255 7/D13
V.4.2 Impact of Cases C, D, B_1, B_2, and B_3 in the Santa Clara County Portion of the Study Area 256 7/E1
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257 7/E3
V.5 ECONOMIC IMPACT ANALYSIS 259 7/E7
V.5.1 Conceptual Level Costs 259 7/E7
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260 7/E9
V.5.3 Economic Impact on Agriculture 260 7/E9
V.6 OTHER IMPACTS 263 7/F1
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264 7/F3
V.6.2 Long-Term Buildup of Salts in Soil 265 7/F5
V.6.3 Public Health Concerns 265 7/F5
V.6.4 Effects on Land Use and Water Use 266 7/F7
V.6.5 Energy Consumption 266 7/F7
V.6.6 Other Effects 267 7/F9

VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270 7/G3
VI.1.1 Disposal of Bittern 271 7/G5
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272 7/G7
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273 7/G9
VI.1.4 Other Disposal Alternatives 276 8/A13
Continued Storage 276 8/A13
On-Land Dilution 276 8/A13
VI.2 PRESENT ENVIRONMENT 277 8/B1
VI.2.1 Physical Environment 277 8/B1
Topography 277 8/B1
Soils 278 8/B3
Sediments 278 8/B3
Hydrology 278 8/B3
Water Quality 278 8/B3
– Temperature and Salinity 278 8/B3
– Chemical Characteristics 280 8/B7
VI.2.2 Biological Environment 280 8/B7
Open Water and Tidal Mud Flats 280 8/B7
Salt Marsh 280 8/B7
Salt Ponds 280 8/B7
Dikes and Levees 282 8/B11
Streams and Sloughs 282 8/B11
Species of Special Concern 283 8/B13
VI.2.3 Social and Cultural Environment 283 8/B13
Recreational Uses of the Area 283 8/B13
Archaeological, Paleontological, Historical, and Cultural Resources 284 8/C1
Visual and Aesthetic Setting 284 8/C1
Existing and Proposed Land Use 284 8/C1
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285 8/C3
VI.3.1 Discharging to Basin Plan Alternative 285 8/C3
Construction Impacts – Physical Environment 285 8/C3
– Topography 285 8/C3
– Air Quality 285 8/C3
– Water Quality 286 8/C5
– Sediment Quality 286 8/C5
– Noise 286 8/C5
Construction Impacts – Biological Environment 286 8/C5
– Salt Pond Dikes 286 8/C5
– Open Water 286 8/C5
Construction Impacts – Social, Economic, and Cultural Environment 287 8/C7
– Recreational Uses of the Area 287 8/C7
– Archaeological, Paleontological, and Historical Resources 287 8/C7
– Economic Setting 287 8/C7
– Present and Projected Land-Use Patterns 287 8/C7
Operational Impacts – Physical Environment 287 8/C7
– Water Quality 287 8/C7
– Sediment Quality 290 8/C13
– Noise 290 8/C13
Operational Impacts – Biological Environment 291 8/D1

Operational Impacts — Social, Economic, and Cultural Environment 292 8/D3
— Economic Setting 292 8/D3
VI.3.2 Discharging Through Separate Diffusers 292 8/D3
Construction Impacts — Physical Environment 292 8/D3
— Topography 292 8/D3
— Air Quality 292 8/D3
— Water Quality 292 8/D3
— Sediment Quality 292 8/D3
— Noise 292 8/D3
Construction Impacts — Biological Environment 293 8/D5
— Salt Pond Dikes 293 8/D5
— Open Water 293 8/D5
Construction Impacts — Social, Economic, and Cultural Environment 293 8/D5
— Recreational Uses of the Area 293 8/D5
— Visual and Aesthetic Setting 293 8/D5
— Economic Setting 293 8/D5
— Present and Projected Land-Use Pattern 294 8/D7
Operational Impacts — Physical Environment 294 8/D7
— Water Quality 294 8/D7
— Sediment Quality 295 8/D9
— Noise 295 8/D9
Operational Impacts - Biological Environment 296 8/D11
Operational Impacts — Social, Economic, and Cultural Environment 297 8/D13
— Economic Setting 297 8/D13
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298 8/E1
VI.4.1 Unavoidable Adverse Environmental Impacts 298 8/E1
VI.4.2 Mitigation Measures 298 8/E1
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299 8/E3
Short-Term Uses of Man's Environment 299 8/E3
Maintenance or Enhancement of Long-Term Productivity 299 8/E3
Need for the Project 299 8/E3
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302 8/E9
Permanent Changes in Land Features and Land Use 302 8/E9
Biological Systems 302 8/E9
Assimilative Capacity of the Bay 302 8/E9
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302 8/E9
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302 8/E9

VII SOURCES OF INFORMATION

VII.1 REFERENCES 305 8/F1
VII.1.1 Literature Cited in Text 305 8/F1
VII.1.2 Literature Cited in Figures 312 8/G1
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313 8/G3
VII.3 CONTACTS 316 8/G9
VII.4 DISTRIBUTION LIST 335 9/D3
VII.4.1 Federal Agencies 335 9/D3
VII.4.2 Libraries 338 9/D9
VII.4.3 Individuals and Private Groups 339 9/D11
VII.4.4 State Agencies 347 9/E13
VII.4.5 Regional Agencies and Local Government 348 9/F1
VII.4.6 Legislators 352 9/F9
VII.4.7 News Media 353 9/F11

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

VI.1.4 OTHER DISPOSAL ALTERNATIVES

Continued Storage

Using existing and new ponds, bittern would be stored indefinitely on Leslie Salt Company property. This alternative was the assumed condition for the description and analysis of the Basin Plan Alternative in Sections I through IV of this report.

Since approximately 200 million gallons per year of bittern are produced, additional salt production ponds would have to be converted to bittern storage. Reduced production of salt would eventually result in an uneconomical enterprise (CDM, 1972). Additionally, the United States Fish and Wildlife Service (USFWS) has expressed concern over the conversion of salt ponds to bittern storage and/or the reduction of salt production. Since a large portion of the Leslie Salt Company holdings in Alameda County are within the San Francisco Bay National Wildlife Refuse, any change in the biological productivity of the salt ponds is of concern to the USFWS. Conversion to bittern reduces biological productivity by increasing the area of toxic water surface in the refuge; reduction or cessation of salt production alters the variation in salinity in the chain of salt ponds within the refuge. For these reasons, this alternative is not considered to be a viable alternative.

On-Land Dilution

The California Department of Fish and Game has expressed concern that the zone of toxicity (the portion of the plume with less than 100:1 dilution) could have adverse impacts on the recovering striped bass fishery in the South Bay as well as impacts on other fish and benthic species, if the bittern were discharged through a separate diffuser system (Section VI.1.2).

In order to minimize the zone of toxicity, the bittern could be diluted 100:1 with Bay water in an on-land facility and then discharged through a diffuser to the Bay. Such an alternative would require a larger discharge pipe than for disposal of undiluted bittern as well as a water supply pipe from the Bay and on-land facilities large enough to hold bittern and Bay water. This alternative would require the commitment of Baylands or the conversion of additional salt production ponds. Since the majority of the Leslie Salt Company holdings in this area are within the San Francisco Bay National Wildlife Refuge, conversion of property for the purposes of on-land dilution would be of concern to the United States Fish and Wildlife Service. Also of concern to the Fish and Wildlife Service is the entrainment of organisms from Newark Slough, a potential diluent source, as a result of pumping. This entrainment would result in a loss of these organisms, a significant adverse impact on the slough's biota. For this reason, this alternative was not considered viable.

VI.2

PRESENT ENVIRONMENT

The existing environmental setting of the South San Francisco Bay is described in Section II of this EIR/EIS. The following discussion is a summary of the environmental conditions in the vicinity of the Dumbarton Bridge.

VI.2.1 PHYSICAL ENVIRONMENT

Topography

In the vicinity of Dumbarton Bridge, San Francisco Bay narrows to a width of approximately 6,200 feet (1,880 meters) at mean higher-high water (MHHW) and has a maximum depth of about 40 feet (12 meters). At mean lower-low (MLLW) the width narrows to approximately 3,300 feet (1,000 meters). The low-lying Baylands that comprise the area from the Bay shore line to the 10-foot contour above mean sea level consist of salt evaporators, sloughs, marshes, and tidal mud flats. An extensive system of dikes and levees separates the salt evaporator system from the other portions of the Bay and therefore constitute a major influence on the human and biological uses of the Dumbarton Straits.

Soils

Harlan Engineers and Applied Soil Mechanics (1973) reported that subsurface conditions at Ravenswood Point, in the vicinity of the western abutment of Dumbarton Bridge, consist primarily of soft clays underlain by firm to stiff clays and moderately dense to dense sands. The soft clays are between 13 and 55 feet deep, deepening at the Bay shore.

The Environmental Protection Agency (EPA) reports similar soil conditions for that portion of the Baylands at the eastern abutment of Dumbarton Bridge. In the Draft Environmental Impact Statement for East Bay Dischargers Authority, the EPA (1975) indicates that Bay Mud deposits are from five feet to 60 feet thick, corresponding generally to the "tidal flats" soil unit described by the USGS (1971).

Where used for foundation purposes, Bay Mud may subside, settle differentially, fail by shearing, shrink, and crack when dry or expand and become plastic when wet. Bay Mud also has a high potential for lurching and sliding during earthquake tremors.

Sediments

Sediments near Dumbarton Bridge are comprised of a thick layer of Bay Mud underlain by a layer of moderately dense to very dense sand and silt. Typical sediment characteristics for this area are given in Table II-2, using boring locations E1, E2, and E3 (Figure II-4). Table VI-2 compares these sediment analyses with EPA dredge spoil characteristics; the sediments from this area meet all current EPA criteria and may be disposed of in open water, as proposed, at the Alcatraz disposal site.

Table VI-2

SEDIMENT SAMPLE ANALYSES AND EPA (1975) DREDGE SPOIL DISPOSAL CRITERIA FOR POLLUTED SPOIL
(Concentrations in ppm, dry weight)

Pollutant Measured	Boring Location E1	E2	E3	EPA Region IX Criterion
Mercury	0.33	0.06	0.05	1.7
Cadmium	<1.2	<0.9	<0.9	3.2
Lead	14.6	7.0	6.6	110.0
Zinc	75.8	38.7	29.3	250.0
Oil and Grease	485	194	187	2,800

Hydrology

Two high and two low waters occur each day with typical diurnal variations in both their magnitude and timing of occurrence. The mean tide range at the Golden Gate is about four feet, whereas at Dumbarton Bridge, the tidal movement virtually produces a standing wave and the mean tidal range is nearly seven feet (CDM, 1972). The maximum tidal fluctuation at Dumbarton Bridge between MLLW and MHHW is about 13.5 feet (U.S. Army Corps of Engineers, personal communication, 1975).

Table II-5 presents typical variations in ebb tide current velocities near Dumbarton Bridge, while Table II-6 illustrates the typical tidal cycle in surface water near the bridge. Tidal flushing is substantial at the Dumbarton Straits but decreases north and south of the bridge as the width of the Bay increases.

Water Quality

Temperature and Salinity. Table VI-3 presents the results of a 1969 survey of water temperature and salinity at Dumbarton Bridge, as reported by CDM (1972). CDM reported these values to be typical of ambient winter conditions in the Bay at that location. Additional measurements by E. H. Smith and Associates for this report (Appendix H) are also presented in Table VI-3. The differences in temperature and salinity can be attributed to seasonal variability; increased tem-

Table VI-3

VARIATION IN SALINITY AND TEMPERATURE AT DUMBARTON BRIDGE

Approximate Depth (meters)	Parameter	Date of Observation							
		CDM Stations(1)		Stations P, Q, R - North of Bridge(2)			Stations T, U, V - South of Bridge(2)		
		1/31/69	2/7/69	10/18/75	3/16/76	7/8/76	10/18/75	3/16/76	7/8/76
0	Temperature (^{o}C)	9.25	10.46	-	15.7	-	-	14.5	-
	Salinity (ppt)	14.42	12.51	-	24.1	-	-	24.4	-
0.5	T	-	-	-	-	-	17.0	-	-
	S	-	-	-	-	-	27.27	-	-
1.0	T	-	-	17.0	-	20.9	-	-	21.2
	S	-	-	27.83	-	30.2	-	-	30.1
1.5	T	9.11	9.91	-	-	-	-	-	-
	S	14.55	12.61	-	-	-	-	-	-
3.0	T	8.97	9.89	-	-	-	-	-	-
	S	14.49	12.78	-	-	-	-	-	-
4.1	T	-	-	17.0	-	20.5	-	-	-
	S	-	-	28.05	-	30.3	-	-	-
5.6	T	-	-	-	-	-	17.0	-	-
	S	-	-	-	-	-	27.74	-	-
6.0	T	9.1	9.84	-	-	-	-	-	-
	S	14.49	12.82	-	-	-	-	-	-
7.2	T	-	-	17.0	-	-	-	-	-
	S	-	-	27.83	-	-	-	-	-
8.7	T	-	-	-	-	-	17.0	-	-
	S	-	-	-	-	-	28.05	-	-
9	T	9.37	9.86	-	14.5	20.5	-	-	20.8
	S	14.49	12.82	-	24.5	29.8	-	-	30.2
12	T	9.40	9.84	-	14.3	-	-	14.2	-
	S	14.49	12.84	-	24.8	-	-	24.9	-

Notes: (1) CDM, 1972.
(2) E. H. Smith and Associates, Appendix H.

perature and salinity are typical of dry summer season conditions (see also Figure III-2).

Chemical Characteristics. Table VI-4 lists some of the chemical parameters measured during two seasons in the vicinity of Dumbarton Bridge. Some parameters, such as BOD, compare favorably with the Lower and Central Bay values given in Table II-7. Others, such as nitrate, are more comparable to South Bay ranges, which are generally higher than other portions of the Bay. In general, the Dumbarton Straits have relatively good water quality and are subject to some of the flushing effects which maintain good water quality in the Lower and Central Bays.

VI.2.2 BIOLOGICAL ENVIRONMENT

Open Water and Tidal Mud Flats

As reported by E. H. Smith and Associates (Appendix H), the common benthic organisms in the Dumbarton Bridge area include species that seem to show a strong seasonal variation. Table VI-5 shows those species found at five Dumbarton Bridge vicinity stations and one Ravenswood Point station in October 1975. These species are typical of the predominantly mud bottom and, in the tidal mud flats, provide a food source for fishes, wading birds, and other carnivores.

Fish species of recreational importance in the South Bay are the sturgeon, the steelhead, and the striped bass. Sturgeons feed along the shallow mud flats of the Bay as do striped bass. Approximately 200 steelhead adults spawned yearly in San Francisquito Creek near Palo Alto prior to the 1976-1977 drought, but no other spawning populations are self-sustaining in the area (California Fish and Game, personal communication, March 1978), and recreational fishing is prohibited along San Francisquito Creek. While there are no tag records for sturgeon catches in the South Bay (California Fish and Game, personal communication, March 1978), they are caught year-round by recreational fishermen (Lane, personal communication, June 1978). Tag returns for striped bass catches south of San Mateo Bridge between 1969 and 1977 ranged from 0.5 percent to 1.0 percent of all tag catches in San Francisco Bay (California Fish and Game, personal communication, March 1978). This does not constitute a significant sport fishery, but striped bass fishing is reported to be improving in the South Bay (Lane, personal communication, June 1978).

Salt Marsh

As shown in Figure II-14, the salt marsh communities in the Dumbarton Bridge vicinity consist of bands of marsh, or "eyebrows," along the fringes of salt ponds and sloughs. The major marsh near the western abutment of Dumbarton Bridge is the Greco Island and Redwood Point marsh, bordered by Redwood Creek, Westpoint Slough, and Ravenswood Slough (California Business and Transportation Agency, 1973). On the eastern side of the Bay, the major marsh habitat consists of the 750 acres near Newark and Mowry Sloughs (EPA, 1975).

Each of the marshes is typified by cordgrass, pickleweed, and other marsh vegetation and provides prime habitat for locally endangered species such as the California clapper rail and salt marsh harvest mouse (Figure II-18). Portions of this marshland are in the San Francisco Bay National Wildlife Refuge (Figure II-23).

Salt Ponds

Salt ponds (Figures II-14 and II-17) are a dominant feature in the vicinity of Dumbarton Bridge. The high salinity ponds and bittern storage ponds are poor habitat for aquatic animals; however, the lower salinity ponds do support moderate to heavy use by shorebirds which feed upon the invertebrate fauna growing in the ponds. Ponds at the western approach to Dumbarton Bridge, designated as 1, 2, and SF-2 in Figure II-17, are part of a series of low salinity ponds. Ponds 1 and 2 are included in the San Francisco Bay National Wildlife Refuge and, like the low to moderately saline

Table VI-4

CHEMICAL ANALYSIS OF SAN FRANCISCO BAY WATER IN VICINITY OF DUMBARTON BRIDGE

Constituent	Concentration(1)						
	CDM Station(2)	Station Q - North of Bridge(3)			Station U - South of Bridge(3)		
	2/16/72	10/18/75	3/16/76	7/8/76	10/18/75	3/16/76	7/8/76
pH	8.1	-	-	-	-	-	-
Total Solids (ppm)	30,631	31,800	29,900	35,200	32,400	31,400	37,300
Total Volatile Solids (ppm)	5,488	-	-	-	-	-	-
Total Suspended Solids (ppm)	44	-	-	-	-	-	-
Total Dissolved Solids (ppm)	30,587	29,200	26,400	30,600	30,400	25,800	31,700
Alkalinity as $CaCO_3$ (ppm)	194	136	116	113	124	116	116
BOD (ppm)	1.2	<1.0	7.7	<1.0	<1.0	7.3	1.2
COD (ppm)	255	-	-	-	-	-	-
Ammonia as N (ppm)	0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Kjeldahl Nitrogen Total (ppm)	1.10	2.00	1.49	0.17	2.28	0.76	0.10
Nitrate as N (ppm)	0.72	0.83	0.32	0.16	0.83	0.18	0.09
Phosphorus Total as P (ppm)	0.41	0.62	0.58	0.45	0.62	0.47	0.55
Chloride (ppm)	17,000	15,800	15,000	17,500	16,000	14,800	17,500
Cyanide (ppm)	<0.04	-	-	-	-	-	-
Fluoride (ppm)	1.21	-	-	-	-	-	-
Phenols (ppb)	<6	-	-	-	-	-	-
Sulfate as S (ppm)	2,400	2,000	1,800	2,100	1,800	1,800	2,100
Sulfide as S (ppm)	<2	-	-	-	-	-	-
TOC (ppm)	18.5	-	-	-	-	-	-
Aluminum (ppb)	200	-	-	-	-	-	-
Arsenic (ppb)	<10	-	-	-	-	-	-
Cadmium (ppb)	<20	<20	<0.002	<0.002	<20	<0.002	<0.002
Calcium (ppm)	380	-	-	-	-	-	-
Chromium (ppb)	<20	-	-	-	-	-	-
Iron (ppb)	20	64	1.02	0.22	40	0.51	0.28
Lead (ppb)	<20	<20	<0.01	0.01	<20	0.01	0.01
Mercury (ppb)	<1	<1	<0.0002	<0.0002	<1	<0.0002	<0.0002
Sodium (ppm)	7,500	8,800	8,100	9,500	8,000	8,200	10,500
Titanium (ppb)	<20	-	-	-	-	-	-
Zinc (ppb)	30	4	0.021	0.016	3	0.019	0.038

Notes: (1) All tests by APHA (1971), EPA (1974), or Strickland and Parsons (1968)
(2) CDM, 1972.
(3) E. H. Smith and Associates, Appendix H.

Table VI-5

COMMON SPECIES AT BENTHIC STATIONS
NEAR DUMBARTON BRIDGE(1)

Organisms(3)	Estimated Numbers/Station(2)					
	Dumbarton Straits Stations					Ravenswood Point
	8	9	10	11	12	7
Polychaeta						
Streblospio benedicti	7	8	8	30	40	52
Asychis elongata	14	24	5	-	4	4
Marphysa sanguinea	7	-	-	-	-	10
Glycinde polygnatha	-	12	2	10	-	4
Neanthes succinea	8	-	-	-	-	-
Nephtys caecoides	-	5	1	5	-	-
Exogone lourei	-	8	-	6	-	19
Heteromastus filiformis	1	-	17	13	12	1
Harmothoe imbricata	-	-	-	-	-	2
Amaeana occidentalis	-	-	-	-	-	2
Bivalvia						
Gemma gemma	26	47	19	12	49	-
Lyonsia californica	8	5	53	28	-	-
Modiolus senhousia	52	185	60	9	106	13
Macoma inguinata	19	-	1	11	5	-
Macoma balthica	6	-	-	-	2	-
Tapes japonica	-	-	-	-	3	5
Arthropoda						
Ampelisca milleri	-	-	13	25	41	75
Oligochaeta						
Peloscolex apectinatus	264	200	120	8	80	8
P. gabriellae	-	-	-	24	-	24
P. nerthoides	-	-	-	1	-	-
Urochordata						
Ciona intestinalis	-	82	-	-	-	-

Notes:
(1) Station locations shown in Figure II-15.
(2) Four grabs/station with 0.05 m^2 surface area each.
(3) Species list based on Table II-9, October 1975 sampling. For other seasonal sampling, see Appendix H.

ponds studied by Carpelan (1957), support a fairly diverse waterfowl population. Bollman, Thelin, and Forester (1970) indicate that average bird counts per visit at these western ponds in 1964 were between 470 and 750 while the eastern ponds ranged from 610 to 770.

Three ponds at the eastern approach to the Bridge were surveyed by Dr. T. H. Harvey and Robert J. Gill, Jr. (California Business and Transportation Agency, 1973) for biological activity. These ponds, designated as 4, 6, and 9 in Figure II-17, were similar to the moderately saline ponds in the series studied by Carpelan (1957) in the Alviso series and supported large numbers of birds during the winter season of 1971-1972. California Business and Transportation Agency (1973) reports that almost 25 percent of the birds counted throughout San Francisco Bay in 1964 and 1965 were found on these three salt ponds.

Dikes and Levees

As described in Section II.1.2, dikes and levees provide relatively isolated habitat for salt marsh and salt tolerant species of plants and nest sites and refuge for birds and animals. The habitat provided by dikes, levees, and other areas of fill is extensive in the Dumbarton Bridge area and contributes significantly to the value of salt marsh and salt pond habitat in this region.

Streams and Sloughs

Newark Slough, Mowry Slough, and Ravenswood Slough are typical of streams and sloughs in the Dumbarton Bridge area. Each is a combination of open water, tidal mud flat, salt marsh, and levee habitat, and each supports a diverse flora and fauna.

Newark Slough is five miles long from its mouth to just south of Silver Pines Golf Course in Newark and ranges from 50 to 300 feet in width. Levees border the slough on each side, as much as 900 feet apart in some locations. Typical animal species are: shad, tomcod, surf perch, sharks, flatfish, rays, and harbor seals in open water; mud snails, worms, clams, mussels, and barnacles on the tidal mud flats; and California clapper rails, salt marsh song sparrows, salt marsh harvest mice, and other birds and mammals in the marsh levee habitats (California Business and Transportation Agency, 1973).

Mowry Slough is known for its colony of over 200 harbor seals (California Business and Transportation Agency, 1973; USDI, 1976), which are apparently increasing in number due to improved water quality and food supplies. These improvements have been attributed by the California Business and Transportation Agency (1973) to increased levels of sewage treatment in the South Bay and Lower Bay.

Ravenswood Slough is about 1.75 miles long and varies in width from 100 to 400 feet. Despite periodic dredging, the slough is rich in marine invertebrates (California Business and Transportation Agency, 1973). Thirty-two species of birds (about 4,000 individuals) were observed in and near the slough in February 1971 by Dr. J. P. Mackey (California Business and Transportation Agency, 1973), indicating that this slough is excellent habitat for waterfowl and other wildlife.

Other sloughs and streams in the Dumbarton Bridge vicinity are Westpoint Slough, Redwood Creek, Smith Slough, Deepwater Slough, Steinberger Slough, Corkscrew Slough (all in or near the Greco Island and Bair Island Units of the San Francisco Bay National Wildlife Refuge), Plummer Creek, Patterson Creek, and Coyote Hills Slough (all within the Fremont, Alameda County Unit of the Refuge).

Species of Special Concern

As described in Section II.1.2, approximately 18 animal species known to occur in the South Bay area are "species of special concern." The ranges of these species, as shown in Figure II-18, do include the Dumbarton Bridge vicinity. In addition, two shellfish beds, one at Ravenswood Point and the other at Dumbarton Point, are found near the bridge. These beds, consisting of Japanese littleneck clams, Bay mussels, softshell clams, and native oysters, are prohibited for human consumption due to contamination from urban runoff and wastewater discharges.

VI.2.3 SOCIAL AND CULTURAL ENVIRONMENT

Recreational Uses of the Area

As described in Section II.1.3, recreational use of the South and Lower Bays is extensive and varied, and the various city and county plans (Section II.2.2) have incorporated extensive parkland and recreational features that will likely increase this use. Recreational areas near the Dumbarton Bridge have been described in Sections II.1.3 and II.2.1. Such areas in San Mateo County include:

- San Francisco Bay National Wildlife Refuge
- Boat harbors at Port of Redwood City, Redwood Shores, and Foster City
- Marine World/Africa U.S.A.

In Alameda County these include:

- San Francisco Bay National Wildlife Refuge
- Coyote Hills Regional Park
- Golf Course at Newark (Silver Pines)

Archaeological, Paleontological, Historical, and Cultural Resources

Surveys by the Adam E. Treganza Anthropology Museum for the East Bay Dischargers Project (EPA, 1975) and by Jerald Johnson of California State University at Sacramento for the South Bayside project (SCSP Committee, 1974) revealed no archaeological or anthropological sites in the salt pond and marsh areas near the bridge. However, as in the survey described in Section II.1.3, the possibility of archaeological sites in the vicinity of stream beds is high, particularly at Coyote Hills and Newark Slough.

No historic sites or landmarks have been identified for this area, but Rancho grant properties such as Rancho Pulgas dominate the shorelines. Cultural artifacts could be encountered throughout the area, particularly during construction activities. These cultural artifacts include Mayhew's Landing (or Beard's Landing), an historic dock used by the original families of Fremont to ship goods to San Francisco (California Business and Transportation Agency, 1973).

Visual and Aesthetic Setting

The western abutment of the Dumbarton Bridge, the radio towers for stations KNBR and KGEI, overhead power lines, and scattered abandoned buildings dominate the aesthetic setting of the Bair Island, Greco Island, and Ravenswood Point area. Similarily, in Alameda County, the eastern approaches to the bridge and KGO radio towers are major visual influences.

Existing and Proposed Land Use

Sections II.2.1 and II.2.2 describe existing and proposed land use in Santa Clara and San Mateo Counties (see also Figures II-23, II-24, and II-25). In the vicinity of the western abutment of the Dumbarton Bridge, existing and planned uses are primarily related to the San Francisco Bay National Wildlife Refuge, the Leslie Salt Company, and scattered commercial, industrial, and utility uses.

The area around the eastern abutment of the Dumbarton Bridge, in Alameda County, is not described in detail in Section II.2. However, existing and planned uses are similar to those at the western abutment, including use by San Francisco Bay National Wildlife Refuge and Leslie Salt Company's salt evaporation system. Within the Fremont Planning Area (EPA, 1975), the acreage around the bridge is dedicated in its entirety to parkland and open space.

VI.3

ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES

VI.3.1 DISCHARGING TO BASIN PLAN ALTERNATIVE

Construction Impacts — Physical Environment

Construction of a Leslie Salt Company conveyance facility and an SBDA/Leslie Salt common diffuser will affect local topography, air quality, water and sediment quality, and noise levels. These impacts will be temporary and relatively minor; however, these effects would be additive to the effects associated with the construction of the Basin Plan Alternative (Section III.1.1).

Topography. Replacement of the pumping station on the eastern side of the Bay would result in localized alteration of the dike of Salt Pond 3 (Figures II-17 and VI-1). This activity might result in a temporary, local increase in turbidity as a result of surface runoff and minor erosion. However, this disturbance is expected to be minor since the site is presently being used as a pumping station and no major excavation or fill activities are anticipated.

Air Quality. Short-term localized impacts on air quality resulting from engine exhaust emissions, generation of fugitive dust, and possible release of naturally occurring hydrogen sulfide and methane gases from anaerobic sediments were attributed to conveyance construction in Section III.1.1. These impacts would extend to the east shore of the Bay with this alternative. Emissions would be localized and temporary, lasting only during construction, and are not considered to be a significant impact.

Water Quality. The entire construction effort for Leslie Salt Company will be limited to the dike of Salt Pond 3 and the deepwater channel north of Dumbarton Straits. Therefore, no dredging activities are anticipated for this system.

Some water quality degradation may occur as a result of sediments being suspended by the divers and their equipment during the connection of the system. However, this minor increase in turbidity and other effects, such as local decreases in dissolved oxygen and increases in heavy metals or nutrients, will be masked by the normally heavy silt load of Bay waters. No significant impact on water quality is anticipated as a result of construction of an SBDA/Leslie Salt common conveyance system.

Sediment Quality. As described above, some sediments may be suspended as a result of construction activities, but no impacts on sediment quality are expected to result from this activity.

Noise. During construction of the SBDA-Leslie Salt common disposal system, pile driving may be necessary. If piles are required for support of the replacement pumping station, pile driving will be a major temporary noise source. As described in Section III.1.1, peak noise levels ranging from 96 to 106 dBA, 50 feet from the source, may be experienced. However, pile driving for the Leslie Salt system would be on the Bay shore, well removed from residential areas. Noise levels from this construction are expected to be the same as those resulting from SBDA in-Bay construction. In both instances, the noise increase will be temporary, lasting only during construction, and may be mitigated by the use of "quiet" equipment (Section III.2).

Construction Impacts — Biological Environment

In addition to the disturbance of biologically productive areas along the Basin Plan Alternative route (Section II.1.1), removal, destruction, or displacement of flora and fauna will occur along portions of the Leslie Salt Company conveyance route and its construction easement. The magnitude of this additional impact will vary with the type and area of habitat crossed. From the replacement pumping station to the connection with the SBDA system in deep water, the existing buried pipeline will be utilized. Therefore, there will be no construction impacts on salt marsh or mud flat habitats.

Salt Pond Dikes. The replacement pumping station will be installed on the outboard dike of Salt Pond 3 (Figure VI-1). This area has been altered, in the past, with the construction of the existing pumping station. However, the station is adjacent to Salt Pond 4, a moderately good waterfowl habitat, and Salt Pond 3 provides nesting habitat for American avocets, Forster's terns, barn and cliff swallows, and the Alameda song sparrow (Gill, 1973). Construction activity and noise may disturb these birds, but this effect should be negligible, since construction can be scheduled to occur in months when nesting is not occurring.

Open Water. Open water habitat will be affected by construction during the positioning of the Leslie Salt connector. At this time, it is not anticipated that the connector will be buried or supported by pilings due to its small size. However, it will preempt some bottom habitat, replacing this mud area with a "new" hard substrate (i.e., the pipe surface). Different species than those now found in the open water habitat are expected to colonize this new substrate. Because the open water habitat is less productive than marsh or mud flats, the impact on biota is not expected to be significant as a result of this construction activity.

Construction Impacts — Social, Economic, and Cultural Environment

Construction activities related to the construction of the Leslie Salt portion of the common disposal system will have some impacts on the social, economic, and cultural environments. These effects by themselves are not expected to be significant, but they will occur in addition to the construction effects of the Basin Plan Alternative and will increase local impact.

Recreational Uses of the Area. The use of support vessels and divers during construction may result in some occasional restriction of recreational traffic through the Dumbarton Straits. Conducting these activities during daylight hours will minimize navigational hazards, however, and no long-term restrictions on the recreational use of the area are anticipated (CDM, 1972).

Archaeological, Paleontological, and Historical Resources. Since no excavation or dredging activities are anticipated, no disturbances of archaeological, paleontological, or historical resources are expected as a result of construction of the Leslie Salt Company-SBDA common disposal system.

Economic Setting. The cost of the Leslie Salt segment of the common disposal system will be borne by Leslie Salt Company. These costs are not significant when compared to the estimated $86.1 million (1975 dollars) for the SBDA conveyance and will probably not affect the local economy. CDM (1972) estimated the costs for construction of a new pipeline and diffuser system to be about $300,000 (1972 dollars). This cost estimate, for purposes of this study, has been taken as the probable maximum cost for construction of the Leslie Salt connector system.

Leslie Salt Company will also pay a proportional share of the cost of the SBDA system downstream of the junction of the two lines. This cost will be based on the capital cost allocation formula described in Section III.1.3, according to flow capacity dedicated to bittern disposal. Leslie Salt's contribution will decrease the cost of the disposal system to each of the participating discharge authorities; however, this decrease is not expected to be significant because of the small capacity utilized by Leslie Salt (0.55 mgd, or less than 0.01 percent of peak flow estimates for 1995).

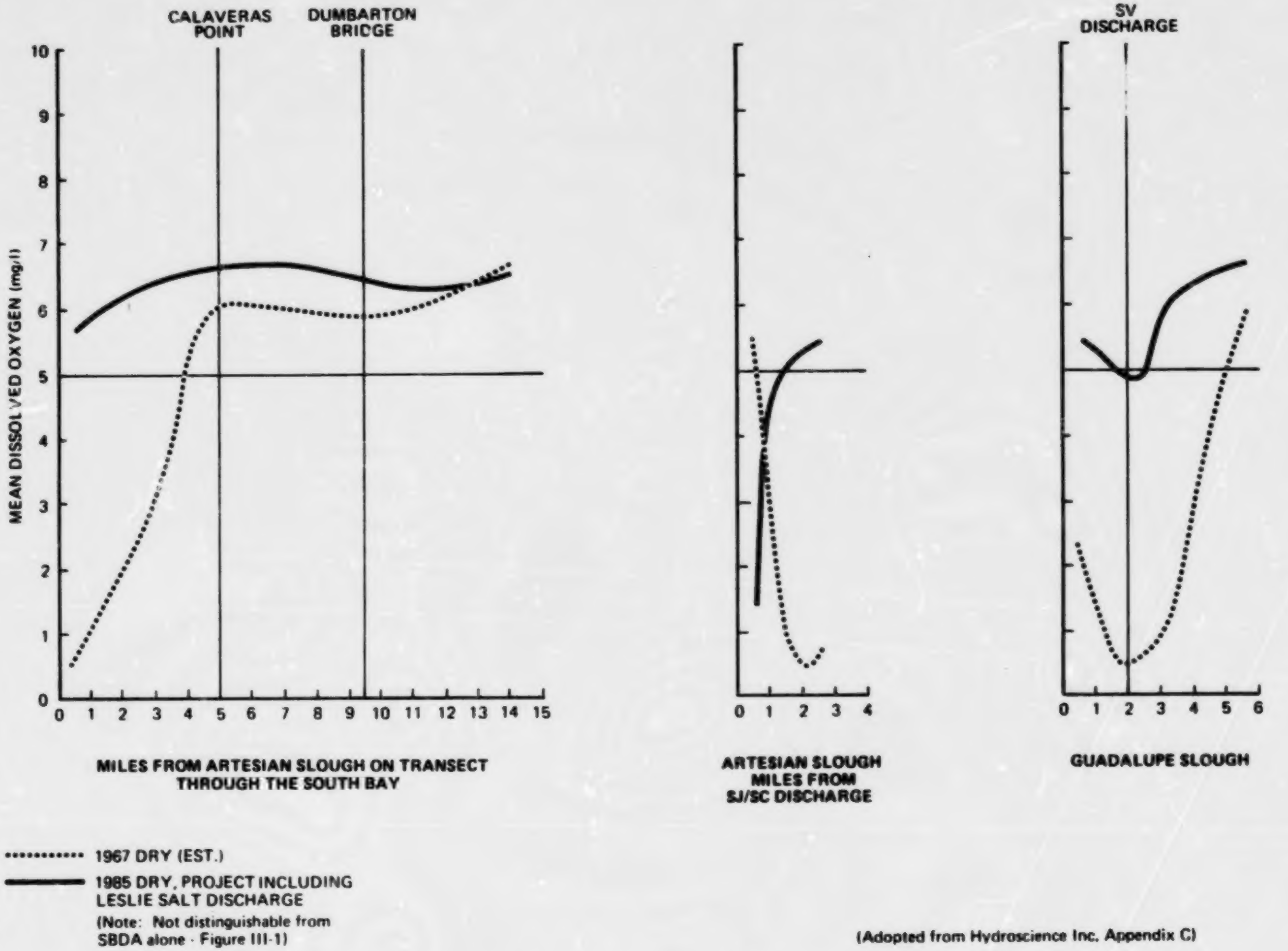
Present and Projected Land-Use Patterns. Since the replacement pumping station will be constructed on land now used by Leslie Salt Company for a pumping station, no change on present land-use will occur. Any disruption of access to Salt Pond 3 will be short-term, affecting only authorized personnel employed or admitted by Leslie Salt Company. No long-term disruption of use of the pond dikes is anticipated.

Operational Impacts — Physical Environment

Operation of an SBDA/Leslie Salt common diffuser system will have potential long-term impacts on Bay water quality, sediment quality, and noise, which may differ from those described for the Basin Plan Alternative in Section III.1.2.

Water Quality. Operational impacts on water quality resulting from the Basin Plan Alternative have been described in Section III.2.1. In brief, this project would result in an improvement in the water quality of South Bay's open waters but will drastically alter the water quality in two sloughs in the South Bay which are presently maintained by wastewater discharge.

Evaluation of the impact of an SBDA/Leslie Salt common outfall on water quality of the South Bay is based on data generated by a steady state model of San Francisco Bay (Appendix C). With this alternative, bittern is diluted 100:1 with SBDA effluent before discharging. Significant alteration in water quality should be restricted to a mixing zone of undetermined size near the discharge ports. Overall, there should be only slight



(Adopted from Hydroscience Inc. Appendix C)

Figure VI-3

MEAN DISSOLVED OXYGEN LEVELS RESULTING FROM LESLIE SALT COMPANY BITTERN BEING DISCHARGED IN COMMON DIFFUSER WITH SBDA (ADOPTED FROM HYDROSCIENCE INC. APPENDIX C)

alteration in water quality for South Bay as a result of bittern discharge, with insignificant changes in dissolved oxygen and salinity, and only a possibly limited effect on toxicity. Individual water quality parameters are discussed below.

- Dissolved Oxygen. Previous studies (Hydroscience, 1975) have shown major sources of oxygen demand to be: (1) carbonaceous and nitrogenous BOD loads from wastewater discharges, (2) oxygen uptake by bottom muds, and (3) carbonaceous and ammonia nitrogen contributions from surrounding marsh lands. Based upon data generated by the steady state model, maximum dissolved oxygen deficits caused by bittern discharge are projected to be 0.03 mg/l, or less than 2.5 percent of the average DO deficits in the disposal area. This predicted oxygen deficit appears to be insignificant and may be too small for the model to predict accurately. The combined discharge of SBDA effluent and Leslie Salt Company's bittern should have a negligible impact on dissolved oxygen concentrations in the South Bay (Figure VI-3).

- Toxicity. Toxicity units, as described in Section II.1.1, can be calculated using bioassay results; equations for this calculation are given in *Tentative Water Quality Control Plan* (SWRCB and RWQCB, 1974) as well as in Appendix C. A limit of 0.05 toxicity units has been established in this plan for ocean waters, but no similar limit has been formulated for estuarine waters. However, the interim *Water Quality Control Plan*, updated in 1973, recommended that relative toxicity not exceed 40 ml/l (or 0.04 unit) in Bay waters. Using this limit as a guideline, it was determined using the Hydroscience model (Appendix C and Section III.1.2, Exhibit III-1) that the proposed project would exceed this relative toxicity limit. If the Leslie Salt Company discharged into the project, the model shows that toxicity concentrations in the vicinity of the disposal point would increase 45 percent above levels that would exist if only SBDA discharged (Figure VI-4). Estimated seasonal increases, resulting from bittern discharges alone, ranged between 20 and 23 ml/l. The increase in toxicity resulting from bittern discharges should have a limited impact on water quality in the outfall vicinity and a negligible impact on the South Bay's open waters.

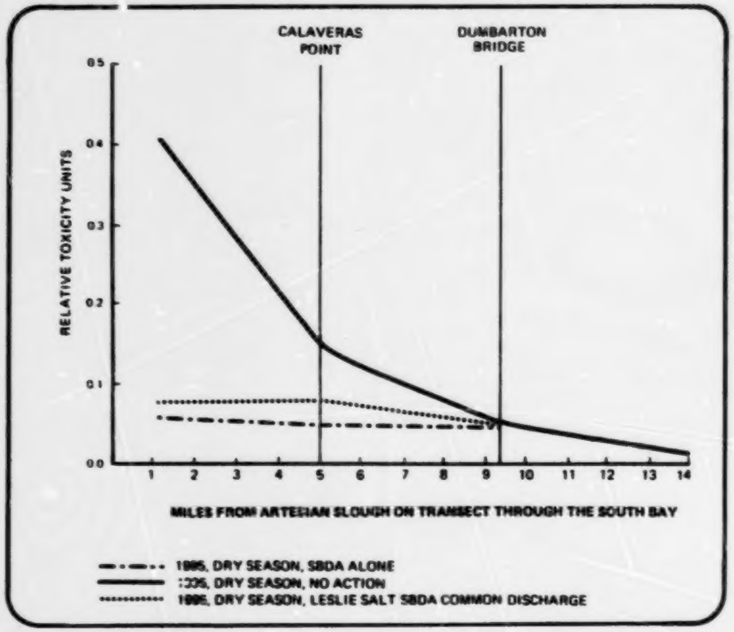


Figure VI-4
RELATIVE TOXICITY IN THE SOUTH BAY RESULTING FROM LESLIE SALT COMPANY BITTERN BEING DISCHARGED IN A COMMON DIFFUSER WITH SBDA (ADOPTED FROM HYDROSCIENCE, INC., APPENDIX C)

These toxicity calculations are based on bioassay results and cannot be used to determine the individual causes of mortality in such tests. In the Leslie Salt Company bioassays, some or all of the mortality could be a result of severe osmotic stress which results from the highly concentrated nature of the bittern, rather than the presence of any particular toxic element such as ammonia or heavy metals. Upon mixing with SBDA wastewater to a 100:1 minimum dilution, such osmotic stress would be reduced (Section VI.1) for many species; similarly, any toxicity resulting to test species as a result of the freshwater nature of SBDA effluent would be altered. Therefore, the toxicity concentrations presented here must be considered a worst-case estimate which assumes that all toxicity in the wastewater and in the bittern is a result of the presence of toxic compounds.

- **Salinity**. The average increase in salinity, expressed as an increase in chlorinity, as a result of bittern discharge is projected to be less than 1.5 percent of the chlorinity concentrations estimated to occur in the outfall vicinity. This increase represents an increase of chlorides of between 170 and 190 ppm in the area south of Dumbarton Bridge (Figure VI-5). This projected increase in salinity appears to be insignificant and may be too small for the model to define accurately. Combined discharge of SBDA treated effluent and Leslie Salt Company's bittern should have a negligible impact on the salinity in the South Bay.

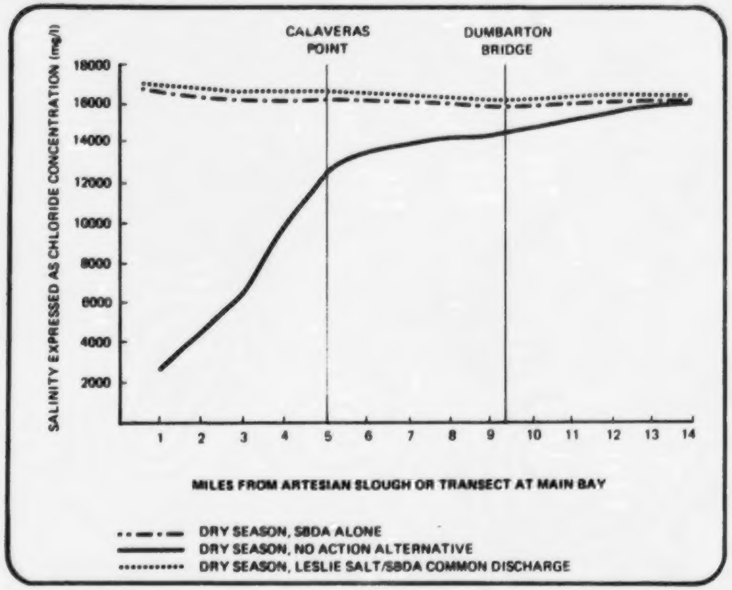


Figure VI-5
PROJECTED SALINITY IN THE SOUTH BAY RESULTING FROM LESLIE SALT COMPANY BITTERN BEING DISCHARGED IN A COMMON DIFFUSER WITH SBDA (ADOPTED FROM HYDROSCIENCE INC., APPENDIX C).

Sediment Quality. Sediment quality near the SBDA/Leslie Salt common diffuser will probably deteriorate to some degree as a result of bittern discharge. The degree of sediment quality degradation is not known, but many of the elements found in bittern, such as heavy metals, tend to associate with the sediments. As with SBDA disposal alone (Section III.1.2), it is likely that some increase in conservative pollutants in the sediments in the vicinity of the common outfall will occur. Since the Leslie Salt Company bittern is derived from the Bay water, upon dilution, these potentially toxic elements will probably behave in a manner similar to that of Bay water, and the net effect on Bay sediments will be small.

Noise. The replacement pump at the east shore of the Bay may contribute to increased noise levels in the area around the pumping station. Since this area is presently being used for a pumping station, the noise impact is expected to be minor. In addition, the area is well removed from residential areas, and access is controlled by Leslie Salt Company, reducing the effect of any increased noise levels.

The present pumping station is operated only during the summer months, while the new station will likely operate year-round (summer for transfer of water from pond SF-2 to pond 3 and winter for diffuser operation). Therefore, the ambient noise levels during winter months will be affected. As described above, the impacts of noise increases are expected to be minimal because of the station's location.

Operational Impacts — Biological Environment

Alterations in Bay water and sediment quality may affect open water biota. The impacts will be a direct result of the quantity and quality of the effluent discharged. As described above in the section on water quality impacts, the depression of dissolved oxygen levels is expected to be undetectable, and no impact on aquatic biota is anticipated due to the slightly lowered dissolved oxygen concentration.

Most of the impact on benthic communities will result from concentration of trace metals in the sediment (Section III.1.2); discharge with SBDA wastewater will ensure a minimum of 100:1 dilution, minimizing the toxic effects of the bittern plume.

Based on analyses performed by Hydroscience, Inc. for the SWRCB (Hydroscience, 1972), toxicity levels, salinity, and benthic species diversity are statistically related. Hydroscience, Inc., states that an increase of toxicity of the magnitude estimated for this alternative could contribute to as much as 10.6 percent depression (wet season) in the benthic species diversity index as a result of implementation of this alternative (Appendix C). In the course of biological sampling (Appendix H), it was determined that sample handling procedures alone could account for variations of between 27 and 92 percent in species abundance estimates. In the case of the South Bay sampling program, these variations were estimated by comparing sieved samples using 0.5 mm screens and smaller screens such as 0.119 mm to determine the percentage of each species that could be "lost" in processing. It was found that counts of preserved aliquots passed through smaller mesh-sized screens were more representative of the true population size.

Other sample handling problems included the accuracy of the grab used to collect the samples; the aggregated nature of benthos distribution which makes the taking of replicate samples difficult; the limitations on the numbers of replicates that could be taken because of the time and cost of analyzing large quantities of material, particularly when dominated by large populations of one or two very small species; and the errors in estimating population sizes necessitated by the analysis of aliquots of samples rather than complete grab samples. These are problems associated with all benthic sampling programs, regardless of location or species composition.

Another possible difficulty in the estimation of a depression in benthic species diversity is the fact that, in San Francisco Bay as in other estuarine systems, a benthic community can vary significantly from season to season as a result of wide variations in growth rates in the represented animal species. For example, some species in the study area exhibited significant population decreases, while others were markedly increasing. These fluctuations could be the result of physical causes for some or all of the species, but many of the more numerous species found in the South Bay *(Gemma gemma,* for example) may have varying reproductive rates depending on physical conditions, season of the year, or the actual density of the species in the benthic community (Appendix H).

Dr. Smith, in his interim baseline report, estimates that only large abundance changes will be seen statistically under such circumstances, and, on the basis of this evaluation, it seems unlikely that a potential for a 10.6 percent depression in diversity indices will be detectable against this large "natural" abundance variation.

Increased noise levels attributable to pumping operation during winter months may disturb waterfowl and other wintering species in Salt Ponds 3 and 4 and their vicinity. Because of the adaptability of wildlife to continuous noise sources and because of the nearby continuing traffic noise source of Dumbarton Bridge, this impact is not expected to affect significantly wildlife population densities or well-being.

Operational Impacts — Social, Economic, and Cultural Environment

The use of the Basin Plan Alternative by Leslie Salt Company is not expected to affect recreational use, the visual setting, present or future land use, or the historical and cultural resources of the area.

Economic Setting. The economic impact of operation of the system (the operating and maintenance costs for the Leslie Salt pumping station and connecting pipeline and for Leslie Salt Company's capacity in the common diffuser) will be paid for by Leslie Salt Company. However, Leslie Salt Company will be able to restore bittern storage ponds to salt production with time and will not have to continue to convert production ponds to storage. This economic benefit is expected to offset the costs of operating the disposal system.

VI.3.2 DISCHARGING THROUGH SEPARATE DIFFUSERS

Construction Impacts — Physical Environment

As described in Section VI.3.1, localized impacts on topography, air quality, water and sediment quality, and noise levels will be temporary and relatively minor. However, the cumulative effects of constructing separate conveyances and diffusers for Leslie Salt Company and SBDA will be greater than for the Basin Plan Alternative alone (Section III.1.1).

Topography. Replacement of the pumping station at the eastern side of the existing pipeline will result in localized alteration of the dike of Salt Pond 3 (Figures II-17 and VI-2). This activity may result in temporarily increased turbidity as a result of surface runoff and minor erosion. However, this disturbance is expected to be minor since the site is presently being used as a pumping station and no major excavation or fill activities are anticipated.

Air Quality. Engine exhaust emissions and generation of fugitive dust are expected to contribute to short-term, localized impacts on air quality. As described in Section III.1.1, these impacts will occur in the vicinity of construction sites, and air quality effects will be extended to the east shore of the Bay with this alternative. Emissions will be small in quantity, temporary (lasting only during construction), and localized and are not considered to be significant.

Water Quality. The entire construction effort for the conveyance and diffuser for Leslie Salt Company will be in the channel of Dumbarton Strait. According to CDM (1972), it was anticipated that much of the diffuser section would be prefabricated on shore and that divers would be used to connect this diffuser section to the existing pipeline. This section would not be buried, and, therefore, no dredging activities are anticipated for this system.

Some water quality degradation may occur as a result of sediments being suspended by the divers and their equipment during the connection of the diffuser. However, this minor increase in turbidity and other effects, such as local decreases in dissolved oxygen and increases in heavy metals or nutrients, will be masked by the normally heavy silt load of Bay waters. No significant impact on water quality is anticipated as a result of construction on the Leslie Salt conveyance and diffuser.

Sediment Quality. As described above, some sediments may be suspended as a result of construction activities. However, no dredging activities will be associated with the Leslie Salt disposal system, and no impacts on sediment quality are anticipated from the construction of this system.

Noise. During construction of the Leslie Salt disposal system, pile driving may be necessary. If piles are required for support of the diffuser section or the replacement pumping station, pile driving will be a major noise source. As described in Section III.1.1, peak noise levels ranging from 96 to 106 dBA may be experienced 50 feet from the source. Since pile driving for the Leslie Salt system will be in the Bay or on the Bay shore, well removed from residential areas, these noise levels are not expected to be perceptible. Noise levels from this construction are expected to be the same as those resulting from Basin Plan Alternative construction. In both instances, the noise increase will be temporary, lasting only during construction, and may be mitigated by the use of "quiet" equipment (Section III.2).

Construction Impacts — Biological Environment

Because the separate diffuser system makes maximum use of existing structures, construction impacts on the Bay biota will be similar to those anticipated for a common disposal system.

Salt Pond Dikes. The replacement pumping station will be installed on the outboard dike of Salt Pond 3 (Figure VI-2). This area has been altered, in the past, with the construction of the existing pumping station. However, the station is adjacent to Salt Pond 4, a moderately good waterfowl habitat, and Salt Pond 3 provides nesting habitat for American avocets, Forster's terns, barn and cliff swallows, and the Alameda song sparrow (Gill, 1973). Construction activity and noise may disturb these birds, but this effect should be minor, since construction can be scheduled for the winter months when nesting is not occurring.

Open Water. Since the open water habitat is less productive than sloughs, salt marshes, or mud flats, the overall impacts on aquatic biota from the construction of a separate diffuser will be less than those resulting from the SBDA system construction. However, habitat for molluscs *(Gemma gemma, Modiolus senhousia)*, oligochaete worms *(Peloscolex apectinatus)*, and polychaete worms *(Streblospio benedicti)* will be affected by construction activities. Portions of this habitat will be destroyed if pile driving is required; other areas will be subjected to small increases in turbidity and sediment redistribution. The diffuser section itself will preempt a 625 by 2 foot area from these typically mud-dwelling species. Different species are expected to colonize the new hard substrate which the diffuser will provide, altering species composition and diversity locally.

Construction Impacts -- Social, Economic, and Cultural Environment

Construction activities related to the separate diffuser system will have direct and indirect impacts on the social, economic, and cultural resources of the area. As discussed earlier, these impacts are expected to be less noticeable than for a common diffuser system because maximum use of existing structures minimizes construction activity. However, impacts resulting from construction of a separate diffuser will be in addition to those resulting from the Basin Plan Alternative alone (Section III.1.1), and, therefore, may result in cumulatively greater impacts than described for the Basin Plan Alternative.

Recreational Uses of the Area. While much of the diffuser section will be assembled on shore to minimize activity in the channel, the use of support vessels and divers during the connection of the diffuser may result in some restriction of recreational traffic through the Dumbarton Straits. Conducting these activities during daylight hours will minimize navigational hazards, however, and no long-term restrictions on the recreational use of the area are anticipated (CDM, 1972).

Visual and Aesthetic Setting. The visual effects of construction will be limited to the open water of the Bay and the dikes of Salt Pond 3. While this activity will be highly visible from Dumbarton Bridge and its eastern approach, it will not be significantly different from routine dredging and salt pond maintenance activities now occurring in that area.

Economic Setting. As a result of construction of a separate diffuser system, approximately $106,000 (1972 dollars as calculated by CDM) will be expended in the project area by Leslie Salt Company. Approximately 25 percent of this cost would be paid out in wages. This cost, even considering the escalation of equipment and labor prices to 1978 dollars, is a small portion of the estimated $86.1 million for the SBDA project. Therefore, impacts on local economy in terms of construction employment and distribution of wages in the community will likely be small.

The major economic impact of this project will be on the Leslie Salt Company. Continued storage of the bittern constitutes an economic burden by reducing production capacity of the salt pond system. Leslie Salt Company, with this project, will be able to restore bittern storage ponds to salt production with time, thus partially offsetting the cost of the disposal system.

Present and Projected Land-Use Patterns. Since the separate diffuser project will utilize, to the extent possible, existing structures belonging to Leslie Salt Company, no impact on present or projected land use is anticipated. Scheduling construction of this system to the winter will reduce interference with current uses of existing structures (now limited to the summer months). Any disruption of access to the dikes of Salt Pond 3 will be short-term, affecting only personnel of Leslie Salt Company and authorized personnel, since access to the ponds is controlled by the company.

Operational Impacts — Physical Environment

Operation of separate diffuser systems will have potential long-term impacts on Bay water quality, sediment quality, and noise, which may differ from those described for the Basin Plan Alternative alone (Section III.1.2) and for a common diffuser system (Section VI.3.1) in both magnitude and location of the effects.

Water Quality. Operational impacts of the Basin Plan Alternative have been described in detail in Section III.2.1. In brief, improved wastewater treatment and discharge will not adversely affect water quality of South Bay open waters. However, drastic water quality alterations can be expected to occur in several sloughs in South Bay, particularly ones maintained by wastewater discharge.

As in Section VI.3.1, evaluation of impacts on South Bay water quality is based on data generated by a steady state model of San Francisco Bay (Appendix C). The proposed plan calls for undiluted bittern to be discharged at model grid point DP26 and for relatively good quality wastewater at grid point DP31. Overall, only a slight change in water quality is predicted for South Bay as a result of bittern discharge when compared to SBDA discharges along. However, this alternative will likely produce localized plumes of bittern and fresh water at DP26 and DP31, respectively. Significant alteration of water quality should be restricted to a narrow zone of undetermined size near each discharge point. For the South Bay, in general, insignificant changes can be expected to occur in dissolved oxygen and salinity concentrations. However, toxicity is projected to be higher than that described in Section VI.3.1. Effects on individual water quality parameters, assuming that the bittern plume diffuses and mixes with surrounding water and does not form a dense saline lens near the discharge point, are discussed in the following paragraphs.

- Dissolved Oxygen. This alternate discharge procedure will produce water quality alterations similar to those described in Section VI.3.1. Maximum dissolved oxygen deficit resulting from bittern discharge is projected to be 0.03 mg/l or less. This deficit appears to be negligible and may be too small for the model to accurately predict.

  Indirect effects on dissolved oxygen levels resulting from the loss of biota due to toxicity in the discharge zone are not considered in the model. In addition, osmotic stress (due to high concentrations of bittern or to ionic imbalance as a result of bittern chemical makeup) may result in a requirement by stressed organisms for higher levels of oxygen than "normal." These requirements may be more significant as a stress on biota than the decrease in DO levels due solely to bittern disposal.

- Toxicity. Toxicity is projected to increase by 30 to 35 ml/l, depending upon seasonal conditions, resulting from discharge of bittern at DP26. This is a 56 percent to 59 percent increase above predicted toxicity for SBDA discharge alone (Figure VI-6). As discussed in Section VI.3.1, the com-

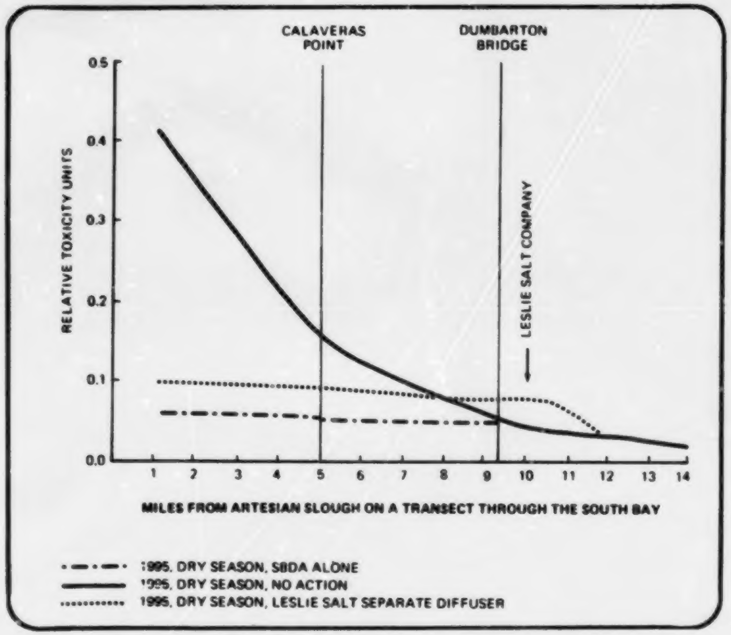


Figure VI-6
RELATIVE TOXICITY IN THE SOUTH BAY RESULTING FROM LESLIE SALT COMPANY BITTERN BEING DISCHARGED FROM A SEPARATE DIFFUSER NEAR DUMBARTON BRIDGE (ADOPTED FROM HYDROSCIENCE, INC., APPENDIX C)

ponents of toxicity cannot readily be defined, and there are no water quality standards for toxicity. California has set a guideline of 40 ml/l for toxicity (Section VI.2.1); however, projections indicate that this value will be exceeded in South Bay even without bittern discharge. The increase in toxicity resulting from bittern discharge through a separate diffuser should have a moderate impact on water quality in the outfall vicinity and a negligible impact on the South Bay's open waters (see Section VI.3.1).

If the plume does not diffuse but, because of density differences between undiluted bittern and Bay water, forms a saline zone, or lens, at the discharge point, the toxicity due to the presence of undiluted bittern would be great. Such lenses have been reported to form in well-mixed flowing fresh water systems when saline brines were discharged (SWRCB, personal communication, March 1978). The CDM (1972) studies indicate that such lens formation can be limited by use of the appropriate jet angles and velocities at the diffuser, and for purposes of this analysis, it was assumed that mixing would occur.

- Salinity. The projected maximum increase in salinity, expressed as an increase in chlorinity, is 1.5 percent. It is identical to that described in Section VI.3.1 (Figure VI-5). This small increase in salinity appears to be negligible and may be too small for the model to accurately predict.

Sediment Quality. Sediment quality near the Leslie Salt Company diffuser will probably deteriorate to some degree as a result of bittern discharge. The degree of sediment quality degradation is not known, but many of the elements found in bittern, such as heavy metals, tend to associate with the sediments. As at the SBDA disposal point (Section III.1.2), it is likely that an increase in conservative pollutants in the sediments in the vicinity of the Leslie Salt diffuser will occur, but the degree of impact on the sediments and associated biota is uncertain since these elements are derived from Bay water and may behave as Bay water upon dilution.

Noise. The replacement pump at the east shore of the Bay may contribute to increased noise levels in the area around the pumping station. Since this area is presently being used for a pumping station, the noise impact is expected to be minor. In addition, the area is well removed from residential areas, and access is controlled by Leslie Salt Company, reducing the effect of any increased noise levels.

The present pumping station is operated only during the summer months, while the new station will likely operate year-round (summer for transfer of water from pond SF-2 to Salt Pond 3 and winter for diffuser operation). Therefore, the ambient noise levels during winter months will be affected. As described above, the impacts of noise increases will be minimized by the station's location.

Operational Impacts — Biological Environment

The operation of the separate diffuser system will have minor, and probably insignificant, impacts on terrestrial habitats. The only evidence of pipeline operation on land will be the noise of the pumping station. However, discharge of small quantities of undiluted bittern may affect aquatic biota indirectly through degradation of water during the winter months.

Impacts on open water and mud flat communities will be a direct result of the quantity of bittern discharged. As described in the section on water quality impacts, the depression of dissolved oxygen levels is expected to be undetectable, and no impact on aquatic biota is anticipated due to slightly lowered dissolved oxygen.

Most of the impact on benthic communities will result from exposure to a portion of the plume that is at less than 100:1 dilution. Similarly, some fishes and invertebrates in the water column near the diffuser will be exposed to bittern that is at less than 100:1 dilution. Bittern that is at less than 100:1 dilution is toxic, and some species mortality would be expected with prolonged exposure. The exact magnitude of loss cannot be calculated; it will vary with a number of factors:

- Characteristics of the plume. According to CDM (1972), the volume, shape, and location of the plume will vary with tidal cycle, season, and quantity of bittern released. Only a portion of the plume would be at less than 100:1 dilution, and the plume of bittern would only occur at the 2.5 hours of maximum ebb in the tidal cycle.
- Sensitivity of the species in the area. The sensitivity of fish, plankton, and benthic species to the toxic elements or the ionic ratios in the plume will vary with species. Test fish used to determine the 100:1 dilution requirement may be less sensitive than other species. Some species will be more sensitive to the total increase in total dissolved salts (here used to define salinity), while others will be sensitive to the changed ionic ratios in bittern that result from the removal of NaCl.
- Ability of species to avoid the plume. Some species cannot move out of the area of plume influence, such as plankton or benthos, and therefore may be exposed to the toxic plume, depending on plume location. Other more mobile species may be able to detect the plume and avoid it; this detection could be based on chemical or physical (turbulence) characteristics.

Therefore, depending on size, location, duration, and dilution of the plume, the exposure of any one individual animal will vary; in addition, the effect of this exposure on the animal will depend on the sensitivity of the animal and its ability to avoid the toxic portion of the plume.

Based on analyses performed by Hydroscience, Inc., for the SWRCB (Hydroscience, 1972), toxicity levels, salinity, and benthic species diversity are statistically related. According to Hydroscience, therefore, an increase of toxicity of the magnitude estimated for this alternative could contribute to as much as 16.5 percent depression (wet season) in the benthic species diversity index as a result of implementing this alternative (Appendix C). In the course of biological sampling (Appendix H), it was determined that sample handling procedures alone could account for variations in species abundance estimates between 27 and 92 percent (Section VI.3.1). Dr. Smith, in his baseline report, estimates that only large abundance changes will be seen statistically under such circumstances, and, on the basis of this evaluation, it seems unlikely that a potential for a 16.5 percent depression in diversity indices will be detectable against this large sample abundance variation.

An impact on the fish community of the Bay may result from the discharge of bittern through a separate diffuser. If migrating species can detect the plume and avoid it, regardless of toxicity effects on those species, an alteration of the use of the South Bay by migratory species could result. For example, if young striped bass avoid the plume in the vicinity of the Dumbarton Strait, a recovery of the non-breeding striped bass population in South Bay could be prevented. Similarly, if migrating steelhead, now known to use San Francisquito Creek in Palo Alto, avoid the plume and if there is no alternative migration route (such as around or over the plume), the steelhead population south of the bridge could be adversely affected. However since sturgeon, steelhead, and striped bass use the shallow areas of the Bay and probably will not be exposed to the plume in the deepwater channel, this plume will not alter use of the flats and sloughs south of San Mateo or Dumbarton Bridges.

Operational Impacts — Social, Economic, and Cultural Environment

The operation of the separate diffuser system for Leslie Salt Company is not expected to affect recreational use, the visual setting, present or future land use, or the historical and cultural resources of the area.

Economic Setting. The major economic impact of operation of the system, the operating and maintenance costs for the pumping station, pipeline, and diffuser, will be borne by Leslie Salt Company. However, Leslie Salt Company will be able to restore bittern storage ponds to salt production in time and will not have to continue to convert production ponds to storage. This economic benefit is expected to offset the costs of operating the disposal system.

VI.4

SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES

Adverse impacts include alteration of topography, erosion, dust, air pollution, noise, degraded water quality, and loss of biological habitat, regardless of the alternative chosen for bittern disposal by Leslie Salt Company. However, the degree of the impact varies slightly with each alternative and would be in addition to the adverse impacts due to the Basin Plan Alternative alone.

VI.4.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

A list of the adverse impacts expected from each bittern discharge alternative is presented in Table VI-6, in comparison with the impacts anticipated from the Basin Plan Alternative alone (Section III.2).

VI.4.2 MITIGATION MEASURES

Construction, operation, and maintenance of the Leslie Salt disposal alternatives will have both beneficial and adverse environmental impacts (Section VI.3). Measures incorporated into engineering design will mitigate some adverse effects. Section III.3 proposes mitigating measures for the Basin Plan Alternative, which, if implemented during construction of either Leslie Salt Company alternative, would minimize adverse impacts. These measures include:

- Revegetation and stabilization of land surfaces, such as dikes, streambeds, and marshes
- Dust abatement methods, such as wetting spoils piles with water
- Bulkheading to protect streams from construction activities and culverting, if necessary, to maintain tidal flow in the streams
- Use of "quiet" equipment for construction

- Inspecting construction site before and during construction for any historical or archaeological sites; removal or preservation of valuable sites after consultation with State Historic Preservation Officer

- Implementing construction safety programs to protect divers and other personnel

- Timing of construction to avoid nesting or breeding seasons of sensitive species

VI.4.3 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Short-Term Uses of Man's Environment

Construction of a conveyance system for either Leslie Salt Company alternative constitutes a short-term use of the local environment. This use includes alteration of land surfaces, local degradation of air and water quality, increased noise levels, and preemption of biological communities. These impacts, described in Section VI.3, will result in a long-term improvement in the use of Leslie Salt Company property.

Maintenance or Enhancement of Long-Term Productivity

No significant degradation in water quality at the alternative discharge points is expected as a result of disposal of bittern in addition to SBDA wastewater, although an increase in toxicity would probably occur in the vicinity of the plume. Similarly, alternative disposal methods are not expected to benefit water quality in San Francisco Bay. However, salt production ponds, now being converted to bittern storage, will be returned to production over a period of years. This constitutes a long-term benefit to the Leslie Salt Company and to the San Francisco Bay National Wildlife Refuge. Restoration of salt ponds will allow the Leslie Salt Company to continue the production of sea salt. This method of salt production consumes very little energy; alternative forms of salt production are more energy intensive. Production of salt by solar evaporation provides economic benefits to the Leslie Salt Company while, at the same time, allows a long-term maintenance of open water surfaces within the wildlife refuge. This open water is quality habitat to many fish and wildlife species (Section VI.2) and will serve to maintain the diversity of the habitat and wildlife within the refuge.

Need for the Project

As described in Section VI.1, the Leslie Salt Company has been converting salt ponds to bittern storage at the rate of one pond per year in order to comply with a request from the Regional Water Quality Control Board to discontinue discharge to Newark Slough. Continued conversion of ponds to bittern storage reduces the productivity of the salt evaporation system by reducing capacity. In addition, the toxic bittern reduces biological productivity of the area by increasing the area of toxic water surface in the wildlife refuge and by restricting the diversity of saline habitats in the area. Continued storage of bittern would eventually result in an uneconomical enterprise to Leslie Salt Company (CDM, 1972) and will degrade the quality of the San Francisco Bay National Wildlife Refuge. A method of disposal of the annual bittern production (201 million gallons per year) is mandatory in order to maintain a productive salt pond system in South San Francisco Bay. The alternatives described in Section VI are those considered to be the least environmentally damaging and the most economically feasible.

Table VI-6

COMPARISON OF SBDA DISCHARGING ALONE WITH ADVERSE ENVIRONMENTAL IMPACTS OF BITTERN DISPOSAL ALTERNATIVES

Environmental Aspect	SBDA Alone, Leslie Salt Zero Discharge	Leslie Salt-SBDA Common Diffuser	Separate Diffusers for Leslie Salt and SBDA
Construction			
Water Quality	Turbidity and degradation from release of benthic pollutants in Bay and streams from 4.2 miles dredged trench and from seven stream crossings	Additional turbidity from construction in Bay — approximately 1.5 miles, no dredging	Additional turbidity from construction in Bay — approximately 1.5 miles, no dredging
Air Quality	Dust, odors, and construction equipment emissions along Baylands and in Bay	Extension of air quality impacts to East Bay	Extension of air quality impacts to East Bay
Noise	Construction activity, including pile driving for portions of in-Bay pipe and for pumping stations	Additional construction noise in East Bay	Additional construction noise in East Bay
Biology — Habitat	1.3 miles in salt marsh, 0.8 mile in mud flats, 4.4 miles in grassland, 3.4 miles in open water, and 2.4 miles in dikes disturbed	Additional small area of open water habitat disturbed	Additional small area of open water habitat disturbed
Biology — Rare or Endangered Species	California clapper rail near Palo Alto section; potential salt marsh harvest mouse population near Palo Alto	No increased impact	No increased impact
Archaeology	No known sites; some potentially sensitive areas in Baylands	No known sites; no increased potential for impact	No known sites; no increased potential for impact
Visibility	In Baylands of Santa Clara County	Extension to East Bay	Extension to East Bay

Table VI-6 (Continued)

Environmental Aspect	SBDA Alone, Leslie Salt Zero Discharge	Leslie Salt-SBDA Common Diffuser	Separate Diffusers for Leslie Salt and SBDA
Land Use	Temporary disruption on land right-of-way	No change	No change
Operation			
Water Quality	Should meet dissolved oxygen standards in open water; Artesian and Guadalupe Sloughs sensitive to reduced flushing and increased salinity; slough may not meet dissolved oxygen standards at all times of year; salinity of South Bay increases to open water levels; potential for slight buildup of conservative elements	Undetectable decrease in DO; undetectable increase in salinity; increased potential for buildup of conservative elements (45 percent increase) using equation for relative toxicity as an indicator and assuming bioassay results entirely due to toxic elements	Undetectable decrease in DO; undetectable increase in salinity; increased potential for buildup of conservative elements (69 percent) using equation for relative toxicity as an indicator and assuming bioassay results entirely due to toxic elements
Biology	Conversion of freshwater habitat in Artesian Slough to tidal marsh; potential degradation of benthos north of bridge at disposal point	Potential 10.6 percent decrease in benthic species diversity at disposal point, during discharge, if relative toxicity estimates are valid. Probably not detectable.	Potential 16.5 percent decrease in benthic species diversity at disposal point, during discharge if relative toxicity estimates are valid. Probably not detectable.
Economics			
Construction and first-year operation cost to proposed project	Estimated to be $86.1 million, 1976 dollars, escalated to 1980	Slight increase in total cost, borne by Leslie Salt	Slight increase in total cost, borne by Leslie Salt
Energy Consumption	Approximately 7.88 million kilowatt-hours per year in 1980	Slight increase due to Leslie Salt pumping station	Slight increase due to Leslie Salt pumping station

VI.4.4 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE PROPOSED ACTIONS SHOULD THEY BE IMPLEMENTED

Permanent Changes in Land Features and Land Use

Either disposal alternative for Leslie Salt Company will preempt future use of the conveyance easement for other uses. The amount of Bay bottom committed varies with the alternative, with the Leslie Salt separate diffuser maximizing the use of existing easements.

The replacement pumping station for either alternative does not constitute a change in present land use, and the increase in land surface area committed to the pumping station is not expected to be significant.

Biological Systems

The rare or endangered species known to occur in the Santa Clara County Baylands (Section II.1.2 and III.5) are also found in Alameda County Baylands (Section VI.3). Permanent detrimental impacts on the habitats of these species are not expected to occur along the conveyance routes, due to the location of the alternative Leslie Salt disposal projects.

Assimilative Capacity of the Bay

The discharge of Leslie Salt bittern constitutes an increase in the commitment of the assimilative capacity of San Francisco Bay waters near Dumbarton Bridge. While bittern discharge does not significantly affect oxygen levels or future loading capacity for oxygen demand, it does contribute slightly to the potential for buildup of heavy metals and other conservative elements in bottom sediments, if these elements behave differently from Bay water upon discharge. This potential buildup could adversely affect future water and sediment quality even if bittern or wastewater discharge were discontinued at some undetermined future date.

Resources Committed to Construction, Operation, and Maintenance of the Alternatives

The principal resources committed to the Leslie Salt alternatives are listed in Table VI-7. These resources constitute an increase over those committed to the Basin Plan Alternative alone (Section III.5.4).

VI.4.5 GROWTH-INDUCING IMPACT OF THE PROPOSED ALTERNATIVES

Because the Leslie Salt Company bittern disposal alternatives will be designed and constructed for operation by an industry and because no industry expansion will result from these alternatives, no direct growth inducing impacts are anticipated for the population or the gross regional product of the area.

Table VI.7

RESOURCES COMMITTED TO THE LESLIE SALT BITTERN DISPOSAL ALTERNATIVES

Resource	SBDA Alone	Leslie Salt Alternatives	
		Common System	Separate Systems
Pipe	20,800 linear feet, 90 inch I.D.; 38,900 linear feet, 96 inch I.D.; and 25,700 linear feet, 102 inch I.D.	Approximately 3,000 linear feet of six inch pipe	Approximately 3,000 feet of 20 inch pipe
Diffuser	450 linear feet, 72 inch I.D. and 256 linear feet, 48 inch I.D.	No increase	Approximately 625 feet of 24 inch pipe
Backfill	497,000 cubic yards	Approximately 50,000 cubic yards additional	Approximately 50,000 cubic yards additional
Spoil	1,166,000 cubic yards at approved disposal sites	No increase	No increase
Pumping stations	Concrete, instrumentation, booster, and mainline pumps at each of three stations	One additional station	One additional station
Manhours	613,000 during construction	No estimate	No estimate x
Capital Cost	$86.123 million	Maximum cost $300,000	$100,000
First Year Operation and Maintenance	$280,000	No estimate	No estimate
Energy Consumption	1.25 x 10^6 kWh/yr at San Jose/ Santa Clara; 2.62 x 10^6 kWh/yr at Sunnyvale; and 4.01 x 10^6 kWh/yr at Palo Alto for a total of 7.88kWh/yr in 1980	Increase due to Leslie pumping system	Increase due to Leslie pumping system

Section VII

SOURCES OF INFORMATION

VII.1

REFERENCES

VII.1.1 LITERATURE CITED IN TEXT

ABAG, 1977a, *Draft Environmental Management Plan for the San Francisco Bay Region; Volumes I, II (Draft EIR), Summary and Recommendations.*

ABAG, 1977b, *Draft Water Quality Management Plan,* 118 pp.

ABAG/MTC, 1974, *Summary of Series 2 Population Projections.*

Agricultural Commission, San Benito County, 1975, *Annual Crop Report.*

AHPA, 1971, *Standard Methods for the Examination of Water and Wastewater,* 13th Edition.

Anderson, W., 1970, A Preliminary Study of the Relationships of Saltponds and Wildlife — South San Francisco Bay, *California Fish and Game,* 56:240-252.

Applied Soil Mechanics Incorporated and Harlan Engineers, 1973, *South Bay Outfall Project, Soil Investigation Report,* Bechtel Incorporated, San Francisco.

Arbuckle, C. and R. Rambos, 1968, *Santa Clara County Ranchos,* The Rosicrucian Press, San Jose, California.

Bay Area Air Pollution Control District, 1972, 1973, 1974, 1975, 1976, *Contaminant and Weather Summary* (monthly).

Bay Area Council, 1978, *A Statement of Key Issues from an Economic Perspective: An Analysis of the ABAG Draft Environmental Management Plan,* 42 pp.

Bay Area Sewage Services Agency, 1973, *San Francisco Bay Region Wastewater Management Facilities Project Coordination Program,* prepared by J. B. Gilbert and Associates, Sacramento and Berkeley.

Bechtel, 1973, *Draft Environmental Impact Report, Overall Program for Water Quality Management in South San Francisco Bay* for SBDA.

Bechtel Incorporated, 1974, *Overview Facilities Management Plan* (OFMP) for SBDA.

Bollman, F.H., P.K. Thelin, and R.T. Forester, 1970, "Bimonthly Bird Counts at Selected Observation Points Around San Francisco Bay, February 1964 to January 1966," *California Fish and Game*, 56:224-239.

Brown and Caldwell, 1974, *Engineering and Assessment of Environmental Impacts for Sunnyvale Water Pollution Control Plant Advanced Waste Treatment Facilities.*

Brown, R.D., Jr. and W.H.K. Lee, 1971, *Active Faults and Preliminary Earthquake Epicenters 1969-1970) in the Southern Part of the San Francisco Bay Region*, U.S. Geologic Survey Field Study, Map MF-307, Department of the Interior. In cooperation with San Francisco Bay Region Environment and Resource Planning Study, Basic Data Contribution 30.

Bryan, G.W., 1976, Some aspects of heavy metal tolerance in aquatic organisms, pp. 7-34, in: Lockwood, A.P.M. (editor), *Effects of Pollutants on Aquatic Organisms*, Society for Experimental Biology Seminar Series 2, Cambridge University Press, Cambridge, England.

Carpelan, L.H., 1957, Hydrobiology of the Alviso Salt Ponds, *Ecology*, 38:375-390.

California Business and Transportation Agency, 1973, *Draft EIS, Dumbarton Bridge Replacement Project*, Department of Public Works, Division of Bay Toll Crossings.

California Department of Fish and Game, 1972, *At the Crossroads, A Report on California's Endangered and Rare Fish and Wildlife.*

California Department of Fish and Game, 1977, *Wastewater Reclamation Policy*, 4 pp. mimeo.

California Department of Finance, 1974, *Population Projections for California 1975-2020: Alternative Series.*

California Department of Health, 1971, *The Use of Sewage for Irrigation, A Literature Review*, State of California Human Relations Agency.

California Department of Health, 1975, *Reliability of Wastewater Reclamation Facilities.*

California Department of Water Resources, 1972, *A Study of Dispersion Capability of San Francisco Bay-Delta Waters.*

California Department of Water Resources, 1974, *San Francisco Bay Area Interagency Wastewater Reclamation Study*, 107 pp.

California Department of Water Resources, 1975a, *California's Groundwater*, DWR Bulletin No. 118, 135 pp.

California Department of Water Resources, 1975b, *Hydrologic Data: 1974, Volume III: Central Coastal Area*, DWR Bulletin No. 130-74, 127 pp.

California Department of Water Resources, 1976, *Preliminary Concepts in the Development of a San Felipe Wastewater Reclamation Project*, unpublished draft MS.

California Department of Water Resources, 1977, *Draft of Report on Reclaimed Wastewater for Agriculture in Santa Clara County*, unpublished MS.

California WDCB, 1977, letter to Municipal Wastewater Dischargers.

CDM, Inc., 1972, *Report on Proposed Discharge of Bittern to San Francisco Bay*, Prepared for Leslie Salt Company, 77 pp.

CDM, 1975, *Report on Proposed Discharge of Bittern through South Bay Dischargers Facilities*, for Leslie Salt Company, 23 pp.

City of Mountain View, 1973, Noise Element.

City of Palo Alto, 1969, *Parks and Recreation Policy Study.*

City of Palo Alto, 1972 Chapter 9.10, Noise, *Municipal Code of the City of Palo Alto.*

City of Palo Alto, 1976, Biological Resource Technical Report, *Supplement to Bay Land Master Plan and EIR.*

City of San Jose, 1966, *The General Plan,* 1966-2010.

City of San Jose, 1975, *San Jose-Santa Clara Water Pollution Control Plant Annual Report 1973,* Department of Public Works, Water Pollution Control Division.

City of Sunnyvale, 1963, Noise or Sound Level, Section 19.24.020,

Conomos, T.J., D.S. McCulloch, D.H. Peterson, and R.P. Carlson, 1971, *Drift of Surface and Near-Bottom Waters of the San Francisco Bay System: March 1970 through April 1971,* U.S. Geological Survey Open File Map, Department of the Interior, in cooperation with San Francisco Bay Region Environment and Resources Planning Study, Basic Data Contribution 22.

Consoer-Bechtel, 1972, *Water Quality Management Plan for South San Francisco Bay, Final Report,* prepared for South Bay Dischargers.

Consoer-Bechtel, 1973, *Water Reclamation and Reuse, A Study for the Santa Clara County Flood Control and Water District, Phase I.*

Consoer-Bechtel, 1974a, *Use of Reclaimed Water for Agricultural Irrigation (Phase I)* for San Felipe Committee.

Consoer-Bechtel, 1974b, *Conceptual Development of a Wastewater Reclamation Alternative for the "San Felipe Committee," An Agricultural Irrigation Water Conveyance System.*

Consoer-Townsend, 1974, *Draft Environmental Impact Report for San Jose-Santa Clara Water Pollution Control Plant Advanced Waste Treatment Facilities.*

County of Santa Clara Department of Agriculture, 1976, *Agricultural Crop Report,* 1975.

Culp/Wesner/Culp, undated, *Example Comparisons of Land Treatment and Advanced Waste Treatment. Design Seminar for Land Treatment of Municipal Wastewater Effluents for EPA.*

Culp/Wesner/Culp, 1974, *Lake Tahoe Advanced Wastewater Treatment Seminar Manual.*

Daniel, Mann, Johnson and Mendenhall, Alan M. Voorhees and Associates, Economics Research Associates, Earth Metrics, Walter E. Gillfillan and Juan S. Vigil, 1977, *Santa Clara Valley Corridor Evaluation, Summary Report, Phase III,* for Joint Policy Committee of ABAG and MTC.

Delisle, G., 1966, *Preliminary Fish and Wildlife Plan for San Francisco Bay-Estuary,* San Francisco Bay Conservation and Development Commission.

Environmental Protection Agency, 1971, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances,* Pub. No. NTID 300.1.

Environmental Protection Agency, Region IX, 1974, *Dredge Spoil Disposal Criteria.*

EPA, 1974, *Manual of Methods for Chemical Analysis of Water and Wastes.*

EPA, 1975a, *Draft Environmental Impact Statement on Proposed Wastewater Management Program for Livermore — Amador Valley, Alameda County, California.*

EPA, 1975b Preparation of Environmental Impact Statements — Final Regulations, *Federal Register,* 40(72) Part III: 16811-16827.

EPA, 1975c, *Draft Environmental Impact Statement, East Bay Dischargers Authority Water Quality Management Program Phase I Project.*

EPA, 1975d, *Alternative Waste Management Techniques for Best Practicable Waste Treatment*, Office of Water Program Operations, Washington, D.C., EPA-430/9-75-013.

EPA, 1977, *Nutrient, Bacterial, and Virus Control as Related to Ground-Water Contamination*, EPA-600/8-77-010, 17 pp.

Environmental Science Associates, 1974, *San Felipe Water Distribution System, Environmental Impact Report, Santa Clara Valley Water District.*

FAO, 1976, *Water Quality for Irrigation*, United Nations, Rome.

FWPCA, 1968, *Water Quality Criteria, A Report of the National Technical Advisory Committee to the Secretary of the Interior*, U.S. G.P.O, Washington, D.C.

Garrett, R.L. and D.J. Mitchell, 1973, *A Study of Prairie Falcon Populations in California*, California Department of Fish and Game, Wildlife Management Branch, Admin. Report 73-2.

Gerow, Bert A., 1968, *An Analysis of the University Village Complex*, Stanford University.

Gill, R., 1973, *The Breeding Birds of the South San Francisco Bay Estuary*, Masters Thesis, California State University, San Jose, 145 pp.

R.C. Harlan and Associates, 1975, *Marine Soils and Sediment – Exploration*, preliminary report.

Harvey, H.T., 1966, *Some Ecological Aspects of San Francisco Bay*, San Francisco Bay Conservation and Development Commission.

Helley, E.J. and E.E. Brabb, 1971, *Geologic Map of Late Cenozoic Deposits, Santa Clara County, California*, United States Department of the Interior.

Helley, E.J., David P. Adam, and Dennis B. Burke, 1972, Late Quaternary Stratigraphic and Paleoecologic Investigations in the San Francisco Bay Area, *Progress Report on the U.S.G.S. Quaternary Studies in the San Francisco Bay Area*, pp. 19-30, United States Department of the Interior.

Helz, G.R., R.J. Huggett, and J.M. Hill, 1975, Behavior of Mn, Fe, Cu, Zn, Cd, and Pb Discharged from a Wastewater Treatment Plant into an Estuarine Environment, *Water Research* 9:631-6.

Holmes, N.A., 1977, "Temperature-Salinity-Vegetation Study of Sewer Slough in the Palo Alto Marsh," unpublished paper prepared for Dr. M.J. Kutilek.

Hunter, B.F., 1970a, Waterfowl Botulism in California – 1969, *California Fish and Game*, 56(3):207-208.

Hunter, B.F., 1970b, Ecology of Waterfowl Botulism Toxin Production, *Transaction of the 35th North American Wildlife and Natural Resource Conference.*

Hunter, B.F., and W.E. Clark, undated, Waterfowl Botulism Management, *Wildlife Management Leaflet No. 14*, California Fish and Game Department.

Hydroscience, Inc., 1972, *Water Quality Analysis of South San Francisco Bay*, in Appendix B of Consoer-Bechtel, 1972, *Water Quality Management Plan for South San Francisco Bay, Final Report.*

Hydroscience, Inc., 1972, A Statistical Evaluation of the Relationship Between Relative Toxicity and Species Diversity Index, in Volume II of *A Study of Toxicity and Biostimulation in San Francisco Bay-Delta Water*, for the SWRCB.

Jenks and Adamson, 1973, *A Program for Water Reclamation and Groundwater Recharge Serving the Palo Alto Bayfront Area*, project report and environmental impact statement prepared for Santa Clara County Flood Control and Water District.

Jenks and Adamson, 1974, *A Program for Water Reclamation and Groundwater Recharge Serving the Palo Alto Bayfront Area*, predesign report prepared for the Santa Clara Valley Water District.

Jenks and Adamson, 1976, *Draft Environmental Impact Report for Palo Alto Water Pollution Control Plant Advanced Waste Treatment Facilities.*

Kaiser Engineers, 1969, *San Francisco Delta Water Quality Control Program*, final report to the State of California

Kibler, D.F., J.R. Monser, and D.L. Tucker, 1975, *Mathematical Model Study of the Palo Alto Flood Basin and Yacht Harbor*, Water Resources Engineers for the City of Palo Alto.

Lagler, K.F., J.E. Bardach, and R.R. Miller, 1962, *Ichthyology*, John Wiley and Sons, Inc., New York, 545 pp.

Lajoie, K.R., E.G. Helley, D.R. Nichols, and D.B. Burke, 1974, *Geologic Map of Unconsolidated and Moderately Consolidated Deposits of San Mateo County, California*, United States Department of the Interior.

Lee, G.F., 1970, *Factors Affecting the Transfer of Materials between Water and Sediments*, Literature Review No. 1, Eutrophication Information Program, Water Resources Center, University of Wisconsin, Madison.

Lee, G.F. and R.H. Plumb, 1975, *Literature Review on Research Study for the Development of Dredged Material Disposal Criteria*, Office of Dredged Material Research, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Contract Report D-74-1.

McCulloch, D.S., D.H. Peterson, P.R. Carlson, and T.S. Conomos, 1970, *A Preliminary Study of the Effects of Water Circulation in the San Francisco Bay Estuary*, Geological Survey Circular 637-A, B, U.S. Department of the Interior.

Mall, R.E., 1969, *Soil-Water-Salt Relationships of Waterfowl Food Plants in the Suisun Marsh of California*, California Department of Fish and Game, Wildlife Bulletin #1.

Martineau, R.T., undated, "A Reconnaissance of Selected Biotic and Physical Aspects of the Palo Alto Flood Basin," memo for City of Palo Alto, Nature and Science staff.

Metcalf and Eddy, 1975, *Design Seminar for Land Treatment of Municipal Wastewater Effluents*, prepared for the U.S. Environmental Protection Agency Technology Transfer Program, 54 pp.

Morel, F.M.M., J.C. Westall, C.R. O'Melia, and J.J. Morgan, 1975, "Fate of Trace Metals in Los Angeles County Wastewater Discharge," *Environmental Science and Technology*, 9(8):756-61.

National Academy of Science, 1972, *Water Quality Criteria.*

Nichols, D.R. and R.H. Wright, 1970, *Preliminary Map of Marshlands, San Francisco Bay, California*, U.S. Geological Survey.

Odum, E.P., 1971, *Fundamentals of Ecology*, Third Edition, W.B. Saunders, U.S., 574 pp.

Parrish, J.M. and B.F. Hunter, 1969, Waterfowl Botulism in the Southern San Joaquin Valley, *California Fish and Game*, 55(4):265-272.

Poland J.R., 1972, Land Subsidence in the Western States Due to Groundwater Overdraft, *Water Resources Bulletin* 8CD.

RWQCB(3), 1975, *Water Quality Control Plan, Central Coastal Basin, California — Abstract*, 54 pp.

Roche, W.M., 1975, Biostimulation Studies in the Suisun Marsh, California, *Proceedings of a Workshop on Algae Nutrient Relationships in the San Francisco Bay Area*, Department of Water Resources, pp. 37-52.

Rosenberg, C.J. and C.M. Salter, "Noise of Pile Driving Equipment," ASA Meeting, Washington, D.C., April 1971.

San Jose, 1977, *GP '75 Land Use/Transportation Diagram.*

San Jose, 1977 *The General Plan 1975*, 59 pp.

San Jose City Council, 1970, *Urban Development Policies.*

San Jose Historic Landmark Commission, 1975, *San Jose Inventory of Its Historical and Architectural Heritage.*

San Mateo County Planning Commission, 1972, *1970 Existing Land Use in Acres.*

Santa Clara City Council, 1970, *General Plan.*

Santa Clara County Department of Agriculture, 1975, *County of Santa Clara Agricultural Crop Reports, 1974.*

Santa Clara County Planning Department, 1949-1974, *Estimated Number of Wage and Salary Workers in Non-Agricultural Establishments by Industry: San Jose Metropolitan Area, Part B.*

Santa Clara County Planning Department, 1967, *Existing Land Use — 1967.*

Santa Clara County Planning Department, 1972, *A Policy Plan for the Baylands of Santa Clara County.*

Santa Clara County Planning Department, 1972a, *A Plan of Regional Parks for Santa Clara County, An Element of the General Plan of Santa Clara County.*

Santa Clara County Planning Department, 1973, *A Plan for the Conservation of Resources, Santa Clara County, An Element of the General Plan of Santa Clara County.*

Santa Clara Valley Water District, 1974, *A Program for Water Reclamation and Groundwater Recharge, Addendum 1974*, Project Report and Environmental Impact Statement.

Santa Clara Valley Water District, 1975, *Master Plan — Expansion of In-County Water Distribution System.*

Santa Clara Valley Water District, 1977, *The Water Utility Enterprise.*

Schaub, D.B., 1971, *Salt Marsh Harvest Mouse Survey, 1971*, California Department of Fish and Game, Special Wildlife Investigation Report W-54-R.

Schlocker, J., 1971, *Generalized Geologic Map of the San Francisco Bay Region, California*, U.S. Geological Survey Open File Map, Department of the Interior. In cooperation with San Francisco Bay Region Environment and Resources Planning Study, Basic Data Contribution 8.

Schmidt, C.J., I. Kugelman, and E.V. Clements, 1975, "Municipal Wastewater Reuse in the U.S.," *J of WPCF*, 47(9): 2229-2245.

S.C.S.P. Committee, 1974, *Final EIR, Strategic Consolidation Plan, South Bayside System Unit, Southern San Mateo County.*

Selleck, R.E., E.A. Pearson, and P.N. Storrs, 1966, *Physical and Hydrological Characteristics of San Francisco Bay*, Volume 4 of *A Comprehensive Study of San Francisco Bay — Final Report*, Sanitary Engineering Research Laboratory Report 65-10, University of California, Berkeley.

State Air Resources Board, Dec. 1972, "California Air Basins," 18 pp.

State Department of Industrial Relations, 1966-1971, *Summary of Employment and Unemployment: San Jose Metropolitan Area, Part A.*

SWRCB, 1972, *A Study of Toxicity and Biostimulation in San Francisco Bay-Delta Waters, Volumes I-VIII.*

SWRCB, 1974, *The Water Quality Control Policy for Enclosed Bays and Estuaries of California.*

SWRCB, 1977, *Policy and Action Plan for Water Reclamation in California*, 121 pp.

SWRCB, 1978, *State of California Water Resources Control Board in 1976-1977: A Biennial Report*, 35 pp.

SWRCB, 1978, Priority list of Reclamation Projects, *Office of Water Recycling Bulletin No. 78-2.*

SWRCB, 1978, *Revisions to the Clean Water Grant Program Regulations Regarding Population Projections, No. 69,* Section 2133(c).

SWRCB and Department of Health, 1977, *Memorandum of Understanding Regarding Use of Reclaimed Water, Draft,* 8 pp.

SWRCB, 1977, *Proposed Amendments to the "Water Quality Control Plan for Ocean Waters of California."*

SWRCB, 1977, *Recommendations for the Integrated Receiving Water Monitoring Program for San Francisco Bay Draft,* 147 pp. plus appendices.

SWRCB and RWQCB, 1974, *Tentative Water Quality Control Plan, San Francisco Bay Region (2)*

SWRCB and RWQCB, 1975, *Water Quality Control Plan, San Francisco Bay Basin, California, Abstract,* 61 pp.

Strickland, J.D.H., and T.R. Parsons, 1968, *A Practical Handbook of Seawater Analysis*, Fisheries Research Board of Canada, Bulletin 167, 311 pp.

Sunnyvale City Council, 1963, *General Plan.*

Tudor Engineering Company, 1973, *Report to the Santa Clara County Flood Control and Water District on the Baylands Salt Water Flood Control Planning Study.*

U.S. Army Corps of Engineers, 1973, *Environmental Assessment and Finding of Fact, Mountain View Shoreline Regional Park,* San Francisco.

U.S. Army Corps of Engineers, 1974, *Survey Report — San Francisco Bay and Sacramento-San Joaquin Delta Wastewater Management Study.*

U.S. Bureau of Census, 1970, *Census of Population.*

U.S. Bureau of Reclamation, 1973, *Hollister Subarea, San Felipe Division, Central Valley Project, Land Classification Appendix and Agricultural and Water Requirement Appendix.*

U.S. Bureau of Reclamation, 1975, *Draft — San Felipe Division Environmental Statement.*

U.S. Bureau of Reclamation, 1976a, *Colorado River Basin Salinity Control Project, Title I Division, Desalting Complex Unit, Arizona, Plan of Development.*

U.S. Bureau of Reclamation, 1976b, *Final San Felipe Division Environmental Statement.*

U.S. Department of Agriculture, 1954, *Agricultural Handbook 60: Saline and Alkali Soils.*

U.S. Department of Agriculture, 1969, *Soil Survey — San Benito County, California.*

U.S. Department of Interior, 1975, Endangered and Threatened Wildlife and Plants, *Federal Register,* 40(188): 44412-44429.

U.S. Department of Interior, 1976, *Acquisition Lands for San Francisco Bay National Wildlife Refuge, Final EIS,* Fish and Wildlife Service.

U.S. Department of Labor, Bureau of Statistics, 1975, *Personal Income Distribution Patterns of the San Francisco-Oakland Area.*

U.S. Geological Survey, 1971, *Distribution of Mercury in Surface Sediments of San Francisco Bay.*

University of California, 1966, *A Comprehensive Study of San Francisco Bay, Volume V,* SERL Report No. 67-2, Berkeley.

Wandolleck, 1975, "A Population Study of the Harvest Mouse in the Palo Alto Saltmarsh," *Wasman Journal of Biology.*

Weddle, C.L. and N.H. Masri, 1972, "Industrial Use of Renovated Municipal Wastewater," *ASME* Paper No. 72-PID-6.

Windom, H.L., 1972, "Environmental Aspects of Dredging in Estuaries," *Journal of the Waterways, Harbors, and Coastal Engineering Division, American Society of Civil Engineeers*, pp. 475-486.

Windom, H.L., 1976, "Environmental Aspects of Dredging in the Coastal Zone," *Critical Reviews in Environmental Control*, 6(2):91-109.

Woodward-Lundgren and Associates, 1974, *Geotechnical Investigation for the Proposed Advanced Waste Treatment Facilities, San Jose-Santa Clara Water Pollution Control Plant*, San Jose, California.

VII. 1.2 LITERATURE CITED IN FIGURES

Bay Area Air Pollution Control District, 1971, *Aviation Effects on Air Quality, San Francisco Bay Region,* for Regional Airport Systems Study, ABAG.

Bay Area Air Pollution Control District, 1972-1973, *Source Inventory of Air Emissions in the San Francisco Bay Area.*

Bay Area Air Pollution Control District, 1972, 1973, 1974, 1975, 1976, *Contaminant and Weather Summary* (monthly).

California Department of Finance, 1974, *Population Projections for California 1975-2020: Alternative Series.*

Garrett, R.L. and D.J. Mitchell, 1973, *A Study of Prairie Falcon Populations in California*, California Department of Fish and Game, Wildlife Management Branch, Admin. Report 73-2.

Gill, R., 1973, *The Breeding Birds of South San Francisco Bay Estuary*, Masters Thesis, California State University, San Jose, 145 pp.

R.C. Harlan and Associates, 1975, *Marine Soils and Sediment - Exploration*, preliminary report, personal communication.

Hydroscience, Inc., 1972, *Water Quality Analysis of South San Francisco Bay,* - Appendix B of Consoer-Bechtel, 1972, *Water Quality Management Plan for South San Francisco Bay Final Report.*

Schaub, D.B., 1971, *Salt Marsh Harvest Mouse Survey, 1971*, California Department of Fish and Game Special Wildlife Investigation Report W-54-R.

Tudor Engineering Company, 1973, *Report to the Santa Clara County Flood Control and Water District on the Baylands Salt Water Flood Control Planning Study.*

U.S. Bureau of Census, 1970, *Census of Population.*

U.S. Department of Interior, 1974, *San Francisco Bay National Wildlife Refuge.*

U.S. Fish and Wildlife Service, 1975, "Threatened or Endangered Fauna or Flora," *Federal Register* 40 (127).

U.S. Geological Survey, 1955, Base Map as modified in Schlocker, J., 1970, *Generalized Geologic Map of the San Francisco Bay Region, California*, Basic Data Contribution 8.

U.S. N.O.A.A., 1951-1960, *Climatography of the United States, Decennial Census of United States Climate, Supplement for California*, No. 86-4.

University of California, 1966, *A Comprehensive Study of San Francisco Bay*, Volume V, SERL Report No. 67-2, Berkeley.

VII.2 PREPARERS OF THE DRAFT EIR/EIS

This Draft Environmental Impact Report and Statement (EIR/EIS) has been prepared under a joint agreement dated 12 March 1975 between the Environmental Protection Agency (EPA), the lead federal agency for the project, and the South Bay Dischargers Authority (SBDA), the lead state agency. Pursuant to this agreement, entitled "Agreement between the U.S. Environmental Protection Agency and the South Bay Dischargers Authority Regarding the Preparation of an Environmental Impact Statement and Provision of Payment Therefor," SBDA engaged Bechtel Incorporated as its consultant to assist EPA in drafting the EIR/EIS. The EIR/EIS project participants and their affiliations are presented below:

Environmental Protection Agency, Region 9

Peter R. Perez	Project Evaluator	30 May 1974 to 21 August 1975
Charles H. Campbell	Project Evaluator	21 August 1975 to 4 June 1976
William Helphingstine	Project Evaluator	4 June 1976 to present

Statewater Resources Control Board

F. W. Pierson	Project Evaluator	30 May 1974 to 8 September 1976
Lyndel Melton	Project Evaluator	8 September 1976 to 16 September 1979
Curtis Swanson	Project Evaluator	16 November 1977 to present

South Bay Dischargers Authority

R. R. Blackburn	City of San Jose Project Coordinator

Technical Advisory Committee

U.S. Army Corps of Engineers	Col. H. A. Flertzheim, Jr.
U.S. Geological Survey	D. S. McCulloch
Department of the Navy Moffett Field Naval Air Station	LCDR W. V. Sayner, Jr., Ens. C. F. Winsor
State Water Resources Control Board	Omer Peck, Howard Wright, Fred Botti, Jim Lee, John Harris, Bob Brown
State Department of Fish and Game III	Michael Rugg
State Lands Commission	Gary Horn
State Department of Public Health	William Joppling and Robert Witt
San Francisco Bay Conservation and Development Commission	Patricia Weesner
Association of Bay Area Governments	Waide Egener and Robert Wong
Bay Area Sewage Services Agency	Dan Murphy and Karol Enferadi
Regional Water Quality Control Board (2)	Robert Scholar, Robert Roche, Val Miller, Don Dalke, A. Van Kleek
U.S. Fish and Wildlife Service, River Basins	R. Breitenbach
U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge	Richard Nugent, Cathy Osugi, and Robert Personius

U.S. Food and Drug Administration	David Alton
Santa Clara Valley Water District	Lloyd Fowler, Val Miller
Santa Clara County Board of Supervisors	County Executive
City of Palo Alto	City Manager and H. R. Remmel
City of Mountain View	Norman H. Lougee
City of Sunnyvale	City Manager and D. M. Somers
City of San Jose	City Manager, F. Belick, A. R. Turturici
City of Santa Clara	Robert R. Mortenson
State Department of Parks and Recreation	
U.S. Department of the Interior, Bureau of Reclamation	Haydn C. Lee, Jr.
Santa Clara County Health Department	E. H. Pearl
San Benito County Board of Supervisors	George E. Shore
University of California, Davis	Dr. Robert Hagen
U.S. Department of Agriculture, Agricultural Extension Service	Robert Ayers
San Jose/Santa Clara Treatment Plant	Advisory Committee (F. Belick, E. Becker)
U.S. Coast Guard, Marine Environmental Protection Branch	N. Bell
San Mateo County Board of Supervisors	County Executive
State Department of Water Resources	Donald Finlayson, Hal Higgins, William Mitchell,Jr
South Santa Clara Valley Water Conservation District	M. Sheehy, D. I. Martin, J. Jeske
Agricultural Extension Service, U.C., County of San Benito	Edward Lydon
Agricultural Extension Service, U.C. County of Santa Clara	Peter Lert

Bechtel

John A. Peterson	Project Manager	30 May 1974 to February 1976
C. M. Spink	Project Manager	February 1976 to present
R. L. Bardin	Project Engineer, supervising design and engineering, pipeline	
C. Cain	Project Engineer, supervising design and engineering, treatment	

Carol M. Harper, Ph.D.	Project Engineer, supervising EIS writing and data gathering
Hsing-Chi Chang, Ph.D.	Noise control technology
Walter T. Clark	Physical geography
David A. Cobb, Ph.D. candidate	Marine biology -- benthos
G. S. Dhillon, Ph.D	Agriculture, soils
S. Douglas	Planning
R. Eggers	Planning
J. W. Gerald, Ph.D	Fisheries
E. Goldman	Environmental monitoring, chemistry
J. D. Gougé	Marine biology - plankton
W. S. Gray, Ph.D	Marine biology - amphipods
Charles A. Harper, Ph.D.	Terrestrial biology - birds and arthropods
J. A. Hepper, Ph.D. candidate	Economics
R. A. Hughes, Ph.D	Water chemistry
Martha H. Kohler, Ph.D	Oceanography and limnology - sediments
Douglas R. Longwell, Ph.D.	Air chemistry
Peter F. Mason, Ph.D	Urban geography
J. J. Meersman	Water quality
Ramon Nugent	Noise control technology
J. L Owen	Terrestrial ecology-botany
F. Z. Patassy	Agronomy and reclamation
Max G. Rodel	Water chemistry
R. B. Scheibach	Groundwater, geology, water quality
Brent P. Sherfey	Economics
C. Valentino	Ecology
John D. Walsh	Meteorology

Consultant to Bechtel Corporation

Michael Melanson	Terrestrial biology - mammals and plants

E. H. Smith and Associates, Sebastopol, CA.

Edmund Smith, Ph.D.	Benthic biological survey and collection of water samples

(for qualifications of technical personnel, see Appendix H)

Archaeological Consulting and Research Services, Inc., Mill Valley, CA.

	Archaeological and paleontological survey

R. C. Harlan and Associates, San Francisco, Ca.

Collection of sediment samples and physical analyses of these sediment samples

Pacific Environmental Laboratory, San Francisco, Ca.

Chemical analyses of sediment and water samples

Hydroscience, Inc., Westwood, New Jersey

Mathematical model of water quality for South San Francisco Bay

VII.3 CONTACTS

During the investigation of regulations and jurisdictions, collections of baseline information and preparation of the Draft EIR/EIS, a number of agencies and individuals were contacted. A listing of these contacts and letters of comment about the proposed project and its alternatives are included in this section.

May 1973		
30	EPA, State Water Resources Control Board, City of San Jose	
June 1973		
19	Consoer Townsend & Associates	
22	City of Palo Alto	A. Remmell, City Engineer E. Crowder, Planning Dept., EIR's L. White, Director, Nature and Science
25	Southern Pacific Co.	Mr. Gallagher, Construction Manager J. Newby, Soils Manager T. Fuller, Bridge Engineer C. Hughes
	Pacific Gas and Electric Co.	G. Lenfesty, Engineering Department J. Kay, Transmission & Distribution Department
	Hetch Hetchy Water	W. Getts
26	City of Sunnyvale	D. Somers, Director of Public Works E. Moore, Planning, Community Dev. Commission G. Miller, Director, Community Dev. Commission H. Abbott, Public Works Supervisor E. Yoshizuka, Associate Engineer J. Wahl, Assistant City Engineer C. Morgan, Water Pollution Control Superintendent J. Bewley, Chemist
26	Santa Clara County Planning Dept.	R. Cameron, Director A. Ogilvie D. Wilcox E. Young R. Hall
27	U.S. Army Corps of Engineers	N. Shimuzu T. Coffman, Geology W. Dickson, Dredging
28	San Mateo County (SMC)	A. Parke, SMC Planning Dept. E. Atkins, East Palo Alto W. Callahan, SMC Managers Office S. Cantwell, SMC Engineers Office V. Sanders, SMC Engineers Office M. Bedwell, City of Menlo Park L. Mercer, City of Menlo Park L. Pirofalo, City of Menlo Park H. Eich, SMC Public Health Engineer S. Coffman, LAFCO

		D. Dowd, Jenks & Adamson (Consultants)
	Santa Clara County Parks and Recreation Dept.	R. Amyx, Director
28	City of Mountain View	A. Shelley, Director of Public Works N. Lougee, Water Division Engineer J. Carlson, Parks Engineer R. Lawrence, Director of Planning
29	Bay Toll Crossings	J. Hawke, Project Manager, Dumbarton Bridge Replacement
July 1973		
2	Bay Conservation & Dev. Commission	J. Blanchfield, Associate Planner L. Tobin, Staff Engineer
	Brown & Caldwell	
3	U.S. Army Corps of Engineers	E. Schleiger, Permit Section Lt. S. Brown, Environmental Section
	San Francisco Bay Wildlife Refuge	W. Stieglitz, Refuge Manager
12	San Francisco Bay Wildlife Refuge	W. Stieglitz, Refuge Manager
	City of Palo Alto	L. White, Director, Nature and Science
18	Leslie Salt Co.	G. Wilkins, Production Manager
Aug. 1973		
1	J.B. Gilbert & Associates	
23	East Palo Alto	J. Hawke, Toll Bridge Adm. B. Schwarz, Toll Bridge Adm. A. Parke, San Mateo County Planning Dept. C. Loucks, City of Menlo Park E. Atkins, East Palo Alto B. Van Horn, East Palo Alto L. Melen, Palo Alto Planning Dept.
27	Santa Clara County	R. Cameron, Director, Planning Dept. A. Ogilvie, Planning Dept. E. Young, Planning Dept. R. Hall, Planning Dept. E. Pearl, Engineer, Public Health Dept.
Sept. 1973		
5	J. B. Gilbert & Associates	
Nov. 1973		
28	San Francisco Bay National Wildlife Refuge	W. Stieglitz, Manager L. Lindeman
	Santa Clara County	R. Cameron, Director Planning Dept. E. Young, Planning Dept. R. Hall, Planning Dept. E. Pearl, Engineer, Public Health Dept.
Feb. 1974		
7	RWQCB 2	Mrs. Wm. M. Eastman
13	Planning Dept. Santa Clara County	R. C. Hall
25	San Mateo County	H. Eich A. Parke W. Powers

March 1974		
13	State Dept. of Fish and Game	M. Rugg
23	San Mateo County Historical Assn. & County Historical Museum	
27	Port Authority Port of Redwood City	Mr. Camble J. Mackenhausen
	Marine World-Africa USA	S. Brown
28	State Historic Preservation Office	W. Pabgett
March 1974		
29	San Mateo County Airport	Mr. Thayer
April 1974		
2	Marine World-Africa USA	S. Brown
2, 5	Society for California Archaeology, Cabrillo College, Aptos, Ca.	R. L. Edwards, Chairman
25	Santa Clara Historical Society	L. M. McKay
May 1974		
31	EPA	P. Perez
	SBDA	R. R. Blackburn
June 1974		
13	SWRCB	J. Diaz H. German
	EPA	P. Perez
	SBDA	A. R. Turturici R. R. Blackburn
24	EPA	P. Perez J. Califf C. Eckerman
	SBDA	F. Belick R. R. Blackburn D. Atkinson
July 1974		
3	EPA	P. Perez
	SBDA	F. Belick R. R. Blackburn D. Atkinson
24	City of Santa Clara	R. Mortensen
	City of Palo Alto	R. Remmel
	City of San Jose	F. Belick R. Naylor J. Ringrose R. R. Blackburn D. Atkinson
	City of Mountain View	
	City of Sunnyvale	D. Somers
	Consoer-Townsend	P. Laubenheimer
	BASSA	D. Hemovich
	ABAG	LuLynn Hurst
	RWQCB 2	R. R. Scholar
	SWRCB	J. T. Allen
	NASA/Ames	G. Holdaway
	EPA	P. Perez
26	RWQCB 2	T. Wu
	EPA	N. Grib, Enforcement

CONTENTS

Section Page

I DESCRIPTION OF BASIN PLAN AND ALTERNATIVES

I.1 DESCRIPTION OF ALTERNATIVES 1 1/D13
I.1.1 Introduction 1 1/D13
I.1.2 Background and Objectives 4 1/E5
I.1.3 Criteria for Evaluation of Alternatives 6 1/E9
I.1.4 Evaluation of Alternatives 6 1/E9
Alternative 2 — No Further Action 9 1/F1
Alternative 3 — Individual Outfalls to Nearest Deepwater 10 1/F3
Alternative 4 — Local Discharge with Upgraded Treatment 11 1/F5
Alternative 5 — Reclamation and Reuse of Treated Wastewater 13 1/F9
I.1.5 Alternative Alignments to Basin Plan Alternative 15 1/F13
I.2 THE BASIN PLAN ALTERNATIVE 19 1/G7
I.2.1 Location 19 1/G7
I.2.2 Facilities for the Basin Plan Alternative 21 1/G11
San Jose/Santa Clara Pumping Station 22 1/G13
Pipeline Segment — San Jose Santa Clara to Sunnyvale 22 1/G13
Sunnyvale Pumping Station 22 1/G13
Pipeline Segment — Sunnyvale to Palo Alto 24 2/B1
Palo Alto Pumping Station 24 2/B1
Pipeline Segment — Palo Alto to Discharge Point 24 2/B1
Diffuser 24 2/B1
I.2.3 Construction of the Basin Plan Alternative 25 2/B3
Construction Procedures on Land 25 2/B3
Construction Procedures in Water 26 2/B5
I.2.4 Operation of the Basin Plan Alternative 28 2/B9
I.3 APPROVALS REQUIRED 29 2/B11

II ENVIRONMENTAL DESCRIPTION

II.1 PRESENT ENVIRONMENT (ENVIRONMENTAL SETTING WITHOUT A PROJECT) 31 2/C3
II.1.1 Physical Environment 31 2/C3
Topography 31 2/C3
Geology and Seismology 33 2/C7
Groundwater 33 2/C7
Soils 36 2/C13
Sediments 37 2/D1
Meteorology 39 2/D5
Air Quality 40 2/D7
— The Air Pollution Problem in the Bay Area 40 2/D7
— Emissions and Air Quality 40 2/D7
— Air Quality in the Bay Area 45 2/E3
— Air Impacts of Wastewater Disposal 45 2/E3
Hydrology 45 2/E3
— Tides and Currents 46 2/E5
— Circulation and Dispersion 47 2/E7
Water Quality 49 2/E11
— Temperature 51 2/F1
— Transparency 51 2/F1
— pH 51 2/F1
— Suspended Solids 51 2/F1
— Salinity 52 2/F3
— Dissolved Oxygen and Oxygen Demand 53 2/F5
— Nutrients 53 2/F5
— Chlorophyll 54 2/F7
— Coliform Bacteria 54 2/F7
— Oil and Grease 55 2/F9
— Toxicity 55 2/F9
— Heavy Metals 57 2/F13
Noise 57 2/F13
II.1.2 Biological Environment 58 2/G1
South Bay Habitats 58 2/G1
— Open Water 61 2/G7
— Tidal Mud Flats 64 2/G13
— Salt Marsh 68 3/B5
— Salt Ponds 71 3/B11
Dikes and Levees 74 3/C3
— Grasslands 75 3/C5
— Streams and Sloughs 75 3/C5
— Freshwater Marshes and Ponds 77 3/C9
Species of Special Concern 78 3/C11

II.1.3 Social, Economic, and Cultural Environment 83 3/D7
Population and Demography 83 3/D7
Recreational and Scientific Uses of the Area 87 3/E1
Archaeological, Paleontological, Historical and Cultural Resources 88 3/E3
– Archaeological Resources 88 3/E3
– Paleontological Resources 89 3/E5
– Historical and Cultural Resources 89 3/E5
Visual and Aesthetic Setting 93 3/E13
Economic Setting 98 3/F9

II.2 LAND USE

II.2.1 Present Land-Use Patterns 101 3/G1
Existing Land Use 101 3/G1
– Santa Clara County 101 3/G1
– San Mateo County 104 3/G7
Existing Public and Private Developments 104 3/G7
Mineral Resources of the Baylands 112 4/B7
II.2.2 Projected Land-Use Patterns 112 4/B7
Planned Public and Private Developments 112 4/B7
Land-Use Plans and Planning Agencies 114 4/B11
Interested Agencies 118 4/C5
– Local 118 4/C5
– Regional 118 4/C5
– State 118 4/C5
– Federal 119 4/C7

II.3 WATER USE

II.3.1 Existing and Proposed Wastewater Treatment Facilities 120 4/C9
San Jose/Santa Clara Regional Water Pollution Control Plant 120 4/C9
Sunnyvale Water Pollution Control Plant 120 4/C9
Palo Alto Treatment Plant 121 4/C11
Menlo Park Sanitary District Wastewater Treatment Plant 121 4/C11
Redwood City Sanitary District – Redwood City Sewage Treatment Facility 121 4/C11
Redwood City Sanitary District – Redwood Shores Plant 122 4/C13
Belmont/San Carlos Joint Sewage Treatment Facility 122 4/C13
Proposed Redwood Shores Subregional Plant 122 4/C13
Union Sanitary District – Alvarado, Plant No. 3 122 4/C13
Union Sanitary District – Newark, Plant No. 1 122 4/C13
Union Sanitary District – Irvington, Plant No. 2 122 4/C13
II.3.2 Current and Projected Sources of Water 122 4/C13
II.3.3 Current Water Use and Projected Demand 123 4/D1
II.3.4 Current and Projected Water Quality 123 4/D1

III ENVIRONMENTAL IMPACTS

III.1 ENVIRONMENTAL IMPACTS OF THE BASIN PLAN ALTERNATIVE 129 4/E1
III.1.1 Construction Impacts 129 4/E1
Physical Environment 129 4/E1
– Topography 129 4/E1
– Air Quality 130 4/E3
– Water Quality 131 4/E5
– Sediment Quality 132 4/E7
– Noise 132 4/E7
Biological Environment 133 4/E9
– Segment I – San Jose/Santa Clara Treatment Plant to Sunnyvale Treatment Plant 134 4/E11
– Segment II – Sunnyvale Pumping Station to Palo Alto Treatment Plant 136 4/F1
– Segment III – Palo Alto Treatment Plant to Discharge Point 138 4/F5
Social, Economic, and Cultural Environment 140 4/F9
– Recreational Uses of the Area 140 4/F9

— Archaeological, Paleontological, and Historical Resources 141 4/F11
— Visual and Aesthetic Setting 141 4/F11
— Economic Setting 141 4/F11
— Present Land-Use Patterns 143 4/G1
— Projected Land-Use Patterns 144 4/G3
III.1.2 Operation Impacts 144 4/G3
Physical Environment 144 4/G3
— Hydrology 144 4/G3
— Water Quality 144 4/G3
— Sediment Quality 148 4/G11
— Noise 150 5/A13
Biological Environment 152 5/B3
Social, Economic, and Cultural Environment 154 5/B7
— Recreational Uses of the Area 154 5/B7
— Visual and Aesthetic Setting 155 5/B9
— Present and Future Land-Use 155 5/B9
— Energy Consumption 155 5/B9
III.1.3 Economic Impact of the Basin Plan Alternative 155 5/B9
Introduction 155 5/B9
Study Assumptions and Methodology 155 5/B9
— Capital Costs 156 5/B11
— Operation and Maintenance Costs 158 5/C1
Computation of Allocation Factors 158 5/C1
User Charges to Discharger Groups 159 5/C3
— Residential Dischargers 159 5/C3
— Commercial Dischargers 159 5/C3
— Industrial Dischargers 159 5/C3
— Direct Impact on Industrial Dischargers 162 5/C9
Analysis of the Canned Fruit and Vegetable Industry 163 5/C11
— Industry Characteristics 163 5/C11
— Methodology 164 5/C13
— Conclusions of Analysis 165 5/D1
Conclusions 165 5/D1
III.1.4 Accident or Natural Catastrophe 166 5/D3
Flooding 166 5/D3
Earthquake 166 5/D3
Plant Upset 166 5/D3
Pumping Station Malfunction 166 5/D3
III.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS 168 5/D7
III.2.1 Adverse Construction Effects 168 5/D7
Physical Environment 168 5/D7
Biological Environment 168 5/D7
Social, Economic, and Cultural Environment 168 5/D7
III.2.2 Adverse Operational Effects 169 5/D9
Physical Environment 169 5/D9
Biological Environment 169 5/D9
Social, Economic, and Cultural Environment 169 5/D9
III.3 MITIGATION MEASURES 170 5/D11
III.3.1 Mitigation of Construction Impacts 170 5/D11
Proposed Measures 170 5/D11
Potential Measures 172 5/E2
III.3.2 Mitigation of Operation Impacts 173 5/E3
Proposed Measures 173 5/E3
Potential Measures 173 5/E3
III.4 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 174 5/E5
III.4.1 Short-Term Uses of Man's Environment 174 5/E5
III.4.2 Maintenance and Enhancement of Long-Term Productivity 174 5/E5
III.4.3 Need for the Project 175 5/E7
III.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES TO THE BASIN PLAN ALTERNATIVE SHOULD IT BE IMPLEMENTED 176 5/E9
III.5.1 Permanent Changes in Land Features and Land Use 177 5/E11
III.5.2 Biological Systems 177 5/E11
III.5.3 Assimilative Capacity of the Bay 177 5/E11
III.5.4 Resources Committed to Construction, Operation and Maintenance of the Basin Plan Alternative 177 5/E11
III.6 CROWTH-INDUCING IMPACT OF THE BASIN PLAN ALTERNATIVE 178 5/E13

IV ALTERNATIVES TO THE BASIN PLAN

IV.1 INTRODUCTION 181 5/F7
IV.2 ALTERNATIVES 182 5/F9

IV.2.1 Alternative 1 — A Single Outfall to the Bay North of Dumbarton Bridge (*Variations*) 183 5/F11
Participation by Other Entities 184 5/F13
Alternative Alignments 184 5/F13
Result of Screening 185 5/G1
IV.2.2 Alternative 2 — No Action Beyond Currently Approved Improvements at the Treatment Plants 188 5/G7
Result of Screening 190 5/G11
IV.2.3 Alternative 3 — Individual Outfalls to Nearest Deep Water 190 5/G11
Result of Screening 191 5/G13
IV.2.4 Alternative 4 — Upgraded Treatment with Continued Local Discharge 193 6/B1
Result of Screening 195 6/B5
IV.2.5 Alternative 5 — Reclamation and Reuse 195 6/B5
Reclamation in Santa Clara County 197 6/B9
Smaller Reuse Markets in the Service Area 199 6/B13
Markets Outside the Service Area 201 6/C3
Result of Screening 202 6/C5
IV.2.6 Alternative 6 — Consolidation with Other Discharger Authorities with a Single Outfall North of San Mateo Bridge 202 6/C5
Result of Screening 203 6/C7
IV.2.7 Alternative 7 - Discharge to the Ocean 203 6/C7
Result of Screening 204 6/C9
IV.2.8 Alternative 8 — Land Disposal 204 6/C9
Result of Screening 205 6/C11
IV.2.9 Alternative 9 — Nonstructural Wastewater Management Considerations 206 6/C13
Result of Screening 206 6/C13
V RECLAMATION AND REUSE AS A WASTEWATER MANAGEMENT OPTION
V.1 INTRODUCTION 207 6/D3
V.2 STUDY AREA 209 6/D7
V.2.1 Location of Study Area 210 6/D9
V.2.2 Water Demand and Supply 210 6/D9
V.2.3 Quality of Groundwater Supplies 213 6/E1
V.2.4 Quality of Soils 213 6/E1
V.2.5 Agricultural Land Use 215 6/E5
V.3 CONCEPTUAL DESIGN 217 6/E9
V.3.1 Potential Markets 218 6/E11
V.3.2 Reclaimed Water Quality 219 6/E13
Source Control 221 6/F3
Level of Reclaimed Water Treatment 222 6/F5
V.3.3 Treatment Conceptual Designs 224 6/F9
Reclaimed Water Flow Diversion 226 6/F13
Coagulation and Sedimentation with Alkalinity Control 226 6/F13
Alkalinity Control 230 6/G7
Partial Desalination Treatment 232 6/G11
V.3.4 Conveyance and Distribution Conceptual Designs 233 6/G13
Pumping 234 7/A13
Conveyance Pipeline 235 7/B1
Santa Clara Valley Distribution System 236 7/B3
Bolsa Distribution System 236 7/B3
User Connections 236 7/B3
V.3.5 Cost Estimates 242 7/C1
Basis of Estimate 242 7/C1
Engineering Construction Management Contingency 244 7/C5
Escalation 244 7/C5
Schedule 244 7/C5
Operation and Maintenance 244 7/C5
Major Exclusions 244 7/C5
Assumptions 244 7/C5
V.3.6 Blending Alternatives 244 7/C5
Blended Water Quality 245 7/C7
Blended Water Markets 245 7/C7
Blended Water Distribution 246 7/C9
Blending System Alternatives 247 7/C11
V.3.7 Alternating Supply Alternatives 247 7/C11
V.3.8 Summary 248 7/C13
V.4 AGRICULTURAL IMPACTS 249 7/D1
V.4.1 Impact of Cases A and B in the Santa Clara County Portion of the Study Area 250 7/D3
Salinity Effects 251 7/D5
Effects of High Sodium Concentrations 253 7/D9

Specific Ion Toxicity 255 7/D13
Summary of Effects on Agriculture of Cases A and B 255 7/D13
V.4.2 Impact of Cases C, D, B_1, B_2, and B_3 in the Santa Clara County Portion of the Study Area 256 7/E1
V.4.3 Impact of Irrigation with Reclaimed Water in the Bolsa Area 257 7/E3
V.5 ECONOMIC IMPACT ANALYSIS 259 7/E7
V.5.1 Conceptual Level Costs 259 7/E7
V.5.2 Federal and State Programs of Financial Assistance for Water Development 260 7/E9
V.5.3 Economic Impact on Agriculture 260 7/E9
V.6 OTHER IMPACTS 263 7/F1
V.6.1 Potential for Contamination of Ground and Surface Water Supplies 264 7/F3
V.6.2 Long-Term Buildup of Salts in Soil 265 7/F5
V.6.3 Public Health Concerns 265 7/F5
V.6.4 Effects on Land Use and Water Use 266 7/F7
V.6.5 Energy Consumption 266 7/F7
V.6.6 Other Effects 267 7/F9

VI ENVIRONMENTAL IMPACTS OF DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

VI.1 DESCRIPTION OF LESLIE SALT COMPANY ALTERNATIVES 270 7/G3
VI.1.1 Disposal of Bittern 271 7/G5
VI.1.2 Leslie Salt Bittern Discharged via Basin Plan Alternative 272 7/G7
VI.1.3 Leslie Salt Bittern Discharged Through a Separate Diffuser 273 7/G9
VI.1.4 Other Disposal Alternatives 276 8/A13
Continued Storage 276 8/A13
On-Land Dilution 276 8/A13
VI.2 PRESENT ENVIRONMENT 277 8/B1
VI.2.1 Physical Environment 277 8/B1
Topography 277 8/B1
Soils 278 8/B3
Sediments 278 8/B3
Hydrology 278 8/B3
Water Quality 278 8/B3
– Temperature and Salinity 278 8/B3
– Chemical Characteristics 280 8/B7
VI.2.2 Biological Environment 280 8/B7
Open Water and Tidal Mud Flats 280 8/B7
Salt Marsh 280 8/B7
Salt Ponds 280 8/B7
Dikes and Levees 282 8/B11
Streams and Sloughs 282 8/B11
Species of Special Concern 283 8/B13
VI.2.3 Social and Cultural Environment 283 8/B13
Recreational Uses of the Area 283 8/B13
Archaeological, Paleontological, Historical, and Cultural Resources 284 8/C1
Visual and Aesthetic Setting 284 8/C1
Existing and Proposed Land Use 284 8/C1
VI.3 ENVIRONMENTAL IMPACTS OF LESLIE SALT DISCHARGE ALTERNATIVES 285 8/C3
VI.3.1 Discharging to Basin Plan Alternative 285 8/C3
Construction Impacts – Physical Environment 285 8/C3
– Topography 285 8/C3
– Air Quality 285 8/C3
– Water Quality 286 8/C5
– Sediment Quality 286 8/C5
– Noise 286 8/C5
Construction Impacts – Biological Environment 286 8/C5
– Salt Pond Dikes 286 8/C5
– Open Water 286 8/C5
Construction Impacts – Social, Economic, and Cultural Environment 287 8/C7
– Recreational Uses of the Area 287 8/C7
– Archaeological, Paleontological, and Historical Resources 287 8/C7
– Economic Setting 287 8/C7
– Present and Projected Land-Use Patterns 287 8/C7
Operational Impacts – Physical Environment 287 8/C7
– Water Quality 287 8/C7
– Sediment Quality 290 8/C13
– Noise 290 8/C13
Operational Impacts – Biological Environment 291 8/D1

Operational Impacts — Social, Economic, and Cultural Environment 292 8/D3
— Economic Setting 292 8/D3
VI.3.2 Discharging Through Separate Diffusers 292 8/D3
Construction Impacts — Physical Environment 292 8/D3
— Topography 292 8/D3
— Air Quality 292 8/D3
— Water Quality 292 8/D3
— Sediment Quality 292 8/D3
— Noise 292 8/D3
Construction Impacts — Biological Environment 293 8/D5
— Salt Pond Dikes 293 8/D5
— Open Water 293 8/D5
Construction Impacts — Social, Economic, and Cultural Environment 293 8/D5
— Recreational Uses of the Area 293 8/D5
— Visual and Aesthetic Setting 293 8/D5
— Economic Setting 293 8/D5
— Present and Projected Land-Use Pattern 294 8/D7
Operational Impacts — Physical Environment 294 8/D7
— Water Quality 294 8/D7
— Sediment Quality 295 8/D9
— Noise 295 8/D9
Operational Impacts - Biological Environment 296 8/D11
Operational Impacts — Social, Economic, and Cultural Environment 297 8/D13
— Economic Setting 297 8/D13
VI.4 SUMMARY OF ADVERSE IMPACTS OF THE TWO ALTERNATIVES 298 8/E1
VI.4.1 Unavoidable Adverse Environmental Impacts 298 8/E1
VI.4.2 Mitigation Measures 298 8/E1
VI.4.3 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 299 8/E3
Short-Term Uses of Man's Environment 299 8/E3
Maintenance or Enhancement of Long-Term Productivity 299 8/E3
Need for the Project 299 8/E3
VI.4.4 Irreversible and Irretrievable Commitments of Resources to the Proposed Actions Should They be Implemented 302 8/E9
Permanent Changes in Land Features and Land Use 302 8/E9
Biological Systems 302 8/E9
Assimilative Capacity of the Bay 302 8/E9
Resources Committed to Construction, Operation, and Maintenance of the Alternatives 302 8/E9
VI.4.5 Growth-Inducing Impact of the Proposed Alternatives 302 8/E9

VII SOURCES OF INFORMATION

VII.1 REFERENCES 305 8/F1
VII.1.1 Literature Cited in Text 305 8/F1
VII.1.2 Literature Cited in Figures 312 8/G1
VII.2 PREPARERS OF THE DRAFT EIR/EIS 313 8/G3
VII.3 CONTACTS 316 8/G9
VII.4 DISTRIBUTION LIST 335 9/D3
VII.4.1 Federal Agencies 335 9/D3
VII.4.2 Libraries 338 9/D9
VII.4.3 Individuals and Private Groups 339 9/D11
VII.4.4 State Agencies 347 9/E13
VII.4.5 Regional Agencies and Local Government 348 9/F1
VII.4.6 Legislators 352 9/F9
VII.4.7 News Media 353 9/F11

Appendices

A Sediment Analyses — 1973 A-1
B Sediment Analyses — 1975 B-1
C Hydroscience, Inc., Model Reports C-1
D RWQCB NPDES Monitoring Data D-1
E San Jose/Santa Clara WPCD Annual Reports E-1
F Noise Survey F-1
G Biota of South San Francisco Bay Area G-1
H Benthic Biology and Water Quality Survey H-1
I Qualitative Terrestrial Ecology Survey I-1
J Archaeological and Paleontological Survey J-1
K BASSA Projections of Water Quality K-1
L Pertinent Regulations L-1

Aug. 1974		
1	RWQCB 2	R. Whitsel
14	EPA	P. R. Perez
	SWRCB	J. T. Allen
	City of San Jose	R. R. Blackburn F. Belick
15	U.S.A. COE Environmental Section	
19	U.S.A. COE Fish and Wildlife Section	
Oct. 1974		
3	California Dept. of Fish & Game	J. W. Emig J. G. Lemieux
	EPA	P. R. Perez
	SWRCB	J. T. Allen
	City of San Jose	F. M. Belick R. R. Blackburn
Nov. 1974		
12	California Dept. of Fish & Game	J. W. Emig J. G. Lemieux
Jan. 1975		
27	U.S. Fish and Wildlife Service	R. Breitenbach, River Basins Division
March 1975		
5	California Parks and Recreation Dept.	W. Padgett
11	EPA	R. Gervais, Attorney R. Foster, Auditor R. Beeler, Audit Manager P. R. Perez, Project Evaluator
	SBDA	R. R. Blackburn D. Atkinson, Attorney
May 1975		
1	SWRCB	F. W. Pierson
6	EPA	J. Califf P. R. Perez
	City of San Jose	R. R. Blackburn
	RWQCB	R. Scholar
	SWRCB	F. W. Pierson J. Diaz
14	EPA	P. R. Perez
20	EPA	P. R. Perez J. Califf M. Evans A. Dong D. Minard D. Cook
	RWQCB	N. Rial A. Oliveri
	USGS	D. McCulloch J. Thompson
	U.S. Army Corps of Engineers	T. Wakeman J. Hendricks
	U.S. Fish and Wildlife Service	R. Breitenbach
	City of San Jose	R. R. Blackburn F. M. Belick
	University of San Francisco	Dr. Gary Stevens, Chairman, Biology
27	EPA	D. Cook
	EPA	P. R. Perez
	RWQCB	N. Rial
	Leslie Salt Co.	G. Wilkins
June 1975		
11	RWQCB	R. Scholar
12	BASSA	K. Enferadi
	ABAG	R. Wong
	RWQCB	R. Scholar
	SWRCB	F. W. Pierson J. Allen

	U.S. Fish and Wildlife Service	R. Breitenbach D. Nugent, S.F. Bay National Wildlife Refuge
	Santa Clara County Health Dept.	E. H. Pearl
	Santa Clara Valley Water District	L. C. Fowler
	U.S. Public Health Service	D. W. Alton
	U.S. Bureau of Reclamation	H. C. Lee
	EPA	P. R. Perez
	City of Mountain View	N. Lougee
	City of Palo Alto	R. Remmel
	City of San Jose	R. R. Blackburn F. M. Belick
	City of Santa Clara	R. Mortenson
June 1975		
13	BASSA	K. Enferadi
	City of Palo Alto	R. Remmel L. White, Nature and Science E. Crowder, Planning D. Holton, Streets Division R. Doty, WQC
	Santa Clara County	H. C. Duncan, Transportation V. Ho
17	City of Sunnyvale	D. M. Somers, Engineer J. Gordon, Planning
18	SWRCB	F. W. Pierson
	RWQCB	N. Rial G. Johnston H. Singer
July 1975		
10	RWQCB	R. Scholar L. Kolb
	SWRCB	F. W. Pierson
	U.S. Fish and Wildlife Service	D. Nugent
	BASSA	K. Enferadi
	ABAG	R. Wong
	Santa Clara County Health Dept.	E. H. Pearl
	Santa Clara Valley Water District	L. F. Cournoyer
	EPA	P. R. Perez
	California Dept. of Fish and Game	M. Rugg
	City of San Jose	F. M. Belick
	City of Sunnyvale	D. M. Somers
	City of Palo Alto	R. Remmel
	City of Santa Clara	R. Mortenson
	Leslie Salt Co.	G. Wilkins
24	Santa Clara County Ext.	W. S. Seyman, Farm Adv. G. H. McNeely, Farm Adv.
	University of California	O. A. Lorenz, Chairman Vegetable Crops
25	Union Sanitary Dist.	R. Forester
	San Mateo Sanitary Dist.	
	San Jose/Santa Clara Sunnyvale STP	E. Becker
29	Peninsula Conservation Center	R. Beaty
31	Santa Clara Valley Water District	Mr. Peterson Mr. Yondell

Aug. 1975		
4	Leslie Salt Co.	G. Wilkins
14	EPA	C. H. Campbell
	California Dept. of Fish and Game	J. G. Lemieux J. Michaels
15	U.S. Fish and Wildlife Service	C. Osugi, Wildlife Refuge
20	U.S. Fish and Wildlife Service	C. Osugi, Wildlife Refuge
Aug. 1975	PUBLIC WORKSHOP — SESSION 1	
21	Sierra Club	J. Baron
	Leslie Salt Co.	C. R. Barner G. Wilkins
	City of San Jose	J. Gray-Hayes, Mayor C. Curtin (for Assemblywoman L. Egland) F. M. Belick, Public Works
	Moffett Field	D. E. Bevere, Public Works LCDR W. V. Saynor U.S.N., Public Works
	Brown and Caldwell	J. T. Bovey
	Ford Motor Co.	J. DeVries
	Cupertino Sanitary Dist.	C. B. Harrison
	NASA Ames Research	G. H. Holdaway
	City of Palo Alto	J. Jenks
	Monsanto Co.	S. D. Lux
	Santa Clara Valley Water Conservation Dist.	D. I. Martin
	Wildlife Refuge Committee	P. McKeehan
	California Canners and Growers	E. O. Mitchell J. Quintal
	California Dept. of Water Resources	P. J. Mitchell J. C. Mosley D. Peterson
	City of Santa Clara	E. Souza (for Agney area residents) R. Mortenson, Water and Sewer Department
	Santa Clara County	E. H. Pearl, Public Health
	Santa Clara Chamber of Commerce	E. Ramey, Industrial Citizens Council
	Alameda County	M. D. Rancer
	Lockheed M&S Co.	M. L. Sellers
	San Mateo Co. Medical Society	R. T. Smith, M.D., Environmental Pollution Commission (also Sierra Club, Loma Prieta Chapter and Sequoia Audubon Society)
	A.A.U.W.	J. Stephenson
	Bay Area League of Industrial Assns.	H. Stone
	California Dept. of Health	H. R. Witt
	ABAG	R. Wong
	PUBLIC WORKSHOP — SESSION 2	
	Santa Clara Valley Coalition	B. Brown

Aug. 1975 21 (Cont'd)	City of San Jose	F. M. Belick, Public Works M. Sheehy, resident
	Dried Fruit Assn. of California	W. W. Dada
	ROAR	M. A. Eklund
	California Dept. of Water Resources	D. Finlayson
	Santa Clara Valley Water District	D. K. Gill
	Cupertino Sanitary Dist.	C. B. Harrison
	Lockheed M&S Co.	W. C. Kossack
	Consoer, Townsend and Assoc.	P. Laubenheimer
	City of Santa Clara	R. Mortenson, Water and Sewer Department
	City of Palo Alto	H. R. Remmel
	Sierra Club, Loma Prieta Chapter	J. Vosti
Sept. 1975 3	EPA	C. H. Campbell P. Utribe P. S. Port A. Mank P. Woods T. Jones E. Soong K. Bigos P. R. Perez
	SBDA	A. R. Turturici R. R. Blackburn
	California Public Health	Wm. Jopling
	U.S. Army Corps of Engineers	J. Harari
	California Dept. of Water Resources	W. B. Mitchell, Jr.
	U.S. Bureau of Reclamation	R. W. Gaines H. Lee, Jr.
	Santa Clara County Ext.	P. Lert G. Carnill
	University of Calif.	R. M. Hagan
	ABAG	R. Wong
	BASSA	K. Enferadi P. Soltow
	Santa Clara County Health	E. H. Pearl
	SWRCB	F. W. Pierson
	RWQCB	R. Scholar
	Santa Clara Valley Water District	D. Gill
	So. Santa Clara Valley Water Conservation Dist.	M. Sheehy
4	EPA	P. R. Perez C. H. Campbell
	SBDA	R. R. Blackburn
16	EPA	C. H. Campbell
18	EPA	C. H. Campbell
	U.S. Fish and Wildlife Service	C. Osugi, Wildlife Refuge
	U.S. Bureau of Reclamation	H. C. Lee
	California DWR	W. B. Mitchell, Jr.
	SWRCB	F. W. Pierson O. Peck
	B.C.D.C.	P. Weesner

Sept. 1975		
	Univ. of California	R. M. Hagan
	ABAG	R. Wong
	BASSA	K. Enferadi
	Santa Clara Valley Water Conservation Dist.	M. Sheehy
	Santa Clara County Health Dept.	E. H. Pearl
	Santa Clara Valley Water Dist.	J. Sanchez
	City of Mountain View	N. Lougee
	City of Santa Clara	R. Mortenson
	City of San Jose	F. M. Belick
	City of Palo Alto	R. Remmel
	RWQCB	R. Scholar
19	EPA	P. Perez, C. H. Campbell
24	Santa Clara Valley Water District	T. McGeary
30	Jenks and Adamson	R. Dowd
	City of San Jose	F. M. Belick
	City of Sunnyvale	D. M. Somers
	City of Palo Alto	R. Remmel
	Peninsula Conservation Center	R. Beatty
October 1975		
2	Wildlife Refuge Cttee.	P. McKeehan
	Santa Clara Valley Coalition	B. Brown
	ROAR	M. Edlund
	California Canners and Growers	R. Ilse D. Winters C. R. Bocks M. P. Filice E. L. Mitchell
6	Sierra Club, Loma Prieta	J. Vosti
8	California Canners and Growers	E. L. Mitchell
9	EPA	C. H. Campbell
	S.F. Bay National Wildlife Refuge	C. Osugi
	U.S. F.W.S.	R. Breitenbach
	Moffett Field	D. Benere
	U.S.A. COE	W. Olsen
	California DWR	W. B. Mitchell, Jr.
	California Fish and Game	M. Rugg
	U.C., Davis	R. M. Hagan
	RWQCB	R. Scholar
	BASSA	K. Enferadi
	ABAG	R. Wong
	SSCVWCD	M. Sheehy
	SCVWD	J. Sanchez
	Santa Clara Country Health	E. H. Pearl
9	U.C. Cooperative Ext.	P. J. Lert
	City of Sunnyvale	D. Somers
	City of Palo Alto	R. Remmel

October 1975		
	City of Mountain View	N. Lougee
	City of Santa Clara	R. Mortenson
	City of San Jose	R. R. Blackburn
13		J. Wandolleck
14	SWRCB	F. W. Pierson
	City of San Jose	R. R. Blackburn
	SCVWD	J. Sanchez
	S.F. Bay National Wildlife Refuge	
	U.S. Army Corps of Engineers	W. Olson W. Brick
	Gangi Brothers	A. R. Gangi
15	BAAPCB	P. Haas
17	PG&E	Mr. Crommer
	California Canners and Growers	E. R. Maitland R. Ilse
20	City of San Jose	F. M. Belick
	Mid-Peninsula Region. Park Dist.	H. Grench
	Beech-Nut, Inc.	G. R. Faxon
	Stokely-Van Camp, Inc.	D. Robbins
	Del Monte Corp.	H. Stone
	National Preserves	D. Winters
	NCC Food Corp.	E. L. Mitchell
21	Santa Clara County Health	E. H. Pearl
23	Ameron	R. Gerke
24	Leslie Salt Co.	G. Wilkins
27	Black and Veatch	H. J. Lobb
	California Canners and Growers	R. Ilse
	Duffy-Mott Co., Inc.	F. P. Hempler
	Contadina Foods, Inc.	J. Stassi
	Libby, McNeill and Libby	C. A. Sigler
28	EPA	G. H. Campbell
	U.C. Cooperative Ext.	P. J. Lert
	SWRCB	O. Peck
	California DWR	W. B. Mitchell, Jr. D. Finlayson
	SBDA	R. R. Blackburn
Nov. 1975		
4	EPA	C. H. Campbell, A. L. Mei
	SBDA	R. R. Blackburn
7	California DWR	W. Mitchell, Jr.
	U.C. Cooperative Ext.	P. J. Lert
11	City of Sunnyvale	M. Somers
	City of Palo Alto	R. Remmel
14	Jenks and Adamson	M. E. Joyce
19	EPA	C. H. Campbell, A. L. Mei
	S.F. Bay National Wildlife Refuge	C. Osugi
	California DWR	W. B. Mitchell, Jr.
	RWQCB	R. Scholar
	BASSA	K. Enferadi

Nov. 1975		
	ABAG	R. Wong, E. Minor
	SCVWD	J. Sanchez
	Santa Clara County Health	W. B. Mapes
	U.C. Cooperative Ext.	P. J. Lert
	U.S. Bureau of Reclamation	H. C. Lee, Jr.
	SWRCB	F. W. Pierson, J. A. Harris
	State Health Dept.	H. R. Witt
	City of Sunnyvale	D. Somers
	City of Palo Alto	R. Remmel
	City of Mountain View	N. Lougee
	City of Santa Clara	R. Mortenson
	City of San Jose	R. R. Blackburn
	Canning Industry	J. A. Quintal
24	ABAG	P. Staub
25	Ameron	R. Gerke
26	EPA	C. H. Campbell A. L. Mei J. Califf R. Gervais
	SWRCB	F. W. Pierson
	RWQCB	R. Scholar
	SBDA	R. R. Blackburn D. Atkinson
	Leslie Salt Co.	G. Wilkins
	Londoli, Ripley and Diamond	E. B. Washburn
Dec. 1975		
2	EPA	C. H. Campbell
	RWQCB	L. P. Kolb
	City of San Jose	R. R. Blackburn F. M. Belick E. R. Becker
	Leslie Salt Co.	G. Wilkins R. Barner
8	City of Jose	F. M. Belick
10	Brown and Caldwell	M. Winer
16	SWRCB	J. Harris
23	California Canners and Growers	R. Ilse
Jan. 1976		
6	California Canners and Growers	R. Ilse E. Mitchell H. Schacht
	Del Monte Corp.	H. Stone M. Rounder
	EPA	R. Coddington J. Pardieck J. Califf R. Gervais A. L. Mei C. Campbell C.
7	Black and Veatch	H. J. Lobb J. G. Buehler
20	Black and Veatch	H. J. Lobb
22	EPA	C. Campbell A. L. Mei
	SFBNWR	C. Osugi
	DWR	W. B. Mitchell
	RWQCB	A. Olivieri
	BASSA	K. Enferadi
	SCVWD	J. Sanchez
	SSCVWCD	M. Sheehy
	Santa Clara Co. Health	E. Pearl
	Santa Clara County Cooperative Ext.	P. Lert

	USBR	H. Lee, Jr. N. Anderson
	NASA-Moffett Field	D. Benere
	SWRCB	O. Peck
	California Fish and Game	J. LeMieux
	State Health	H. R. Witt
	City of Sunnyvale	D. Somers
	City of Palo Alto	R. Remmel
	City of Santa Clara	R. Mortensen
	City of San Jose	R. Blackburn F. Belick
29	Brown and Caldwell	F. M. Verlander
Feb. 1976		
18	EPA	C. Campbell A. L. Mei
	SWRCB	F. W. Pierson J. Harris
	RWQCB	R. Scholar V. Miller
	SBDA	R. Blackburn
Apr. 1976		
28	EPA	C. Campbell
	RWQCB	R. Scholar V. Miller
	BASSA	K. Enferadi
	ABAG	R. Wong
	Santa Clara Co. Health	E. Pearl
	USBR	H. Lee, Jr.
	California Fish and Game	M. Rugg
	City of Palo Alto	R. Remmel
	City of Mountain View	N. Longee
	City of San Jose	R. Blackburn
July 1976		
28	SWRCB	F. W. Pierson
Aug. 1976		
5	SWRCB	F. W. Pierson E. Dito
	City of San Jose	R. Blackburn F. Belick
Sept. 1976		
8	EPA	C. Campbell
	SWRCB	F. W. Pierson L. Melton
	City of San Jose	R. Blackburn
Feb. 1977		
16	EPA	W. Helphingstine
	SWRCB	L. Melton
	RWQCB	V. Miller
	SBDA	R. Blackburn
Mar. 1977		
1	SWRCB	L. Melton
	RWQCB	V. Miller
	State Health	W. F. Jopling R. Witt
	City of San Jose	R. Blackburn F. Belick
2	State Health	R. Witt
8	Santa Clara County Cooperative Ext.	P. Lert
	DWR	B. J. Archer
11	USBR	H. Lee, Jr.
14	SWRCB	L. Melton F. Bott

Mar. 1977		
	RWQCB	V. Miller
		R. Scholar
		D. Dalke
		R. Roche
	SSCVWCD	D. I. Martin
	Santa Clara County Cooperative Ext.	P. Lert
	San Benito Co. Agricultural Ext.	R. Lydon
	State Health	R. Witt
	ABAG	R. Wong
	Santa Clara Co.	W. Mapes
	NASA-Moffett Field	Ens. C. F. Winsor
	SCVWD	L. Cournoyer
	DWR	H. Higgins
		D. Finlayson
	City of San Jose	R. Blackburn
		F. Belick
	City of Palo Alto	R. Remmel
	City of Santa Clara	R. Mortenson
	City of Sunnyvale	D. Somers
15	RWQCB	L. Martini
18	ABAG	S. Silverman
21	SFBNWR	R. Personius
	RWQCB	R. Scholar
		G. Johnston
28	SFBNWR	R. Personius
29	BCDC	M. Tobin
31	Santa Clara Co.	G. Steinberg
		S. Sanchez
	Santa Clara Co. Planning Dept.	R. Sturdevandt
	Santa Clara County Cooperative Ext.	P. Lert
	ABAG	J. Naftzger
Apr. 1977		
4	State Health	R. Witt
7	RWQCB(3)	Public Inf. Officer
9	City of Palo Alto	Nancy Holmes
	SFBNWR	R. Personius
		R. Maywalt
May 1977		
18	SWRCB	L. Melton
		F. Botti
	EPA	W. Helphingstine
		M. Zuckerman
	RWQCB	V. Miller
	SSCVWCD	J. Jeske
	SCVWD	L. Cournoyer
	USBR	H. Lee, Jr.
	DWR	D. Finlayson
	FDA	D. Alton
	City of Palo Alto	R. Remmel
	City of Sunnyvale	D. Somers
	City of San Jose	E. Jacobi
19	SFBNWR	R. Personius
20	Santa Clara	G. Heeg
	Kriegan, D'Angelo	S. Kulakow
23	SWRCB	L. Melton
June 1977		
1	SCVWD	L. Cournoyer
		W. Hoeft
2	Tilden Park	R. Russo
3	Quicksilver	M. Burnstein
	SFBNWR	R. Personius
23	RWQCB	R. Scholar
		A. Van Kleek
		R. Roche
	SWRCB	L. Melton
		J. Harris

	City of Palo Alto	R. Doty
	City of San Jose	R. Blackburn
		F. Belick
Undated	USDA SCSS	
	USDA Salinity Laboratory	
Aug. 1977		
9	SWRCB	L. Melton
	SBDA	R. Blackburn
15	SWRCB	L. Melton
		J. Harris
Sept. 1977		
14	SWRCB	L. Melton
		J. Lee
	EPA	W. Helphingstine
	DWR	D. Finlayson
	Santa Clara Co. EMA	W. Mapes
	RWQCB	A. Van Kleek
	SCVWD	V. Miller
	SSCVWCD	J. Jeske
	USBR	H. Lee, Jr.
	State Health	R. Witt
	City of Mountain View	N. Lougee
	City of Santa Clara	R. Mortenson
	City of Sunnyvale	D. Somers
	City of San Jose	R. Blackburn
	City of San Jose	F. Belick
	City of Palo Alto	R. Remmel
	City of Sunnyvale	D. Somers
	Union San. Dist.	Mrs. Mays
Oct. 1977		
3	EIP	S. Krenzelok
26	SWRCB	F. W. Pierson
Nov. 1977		
8	SWRCB	J. Harris
10	SWRCB	J. Harris
	RWQCB	F. Jarvis
		R. Roche
10	SWRCB	E. Dito
16	SWRCB	E. Dito
		C. Swanson
	SBDA	R. Blackburn
Dec. 1977		
12	City of Sunnyvale	D. Somers
	SWRCB	J. Harris
	Leslie Salt Co.	Blair Armstrong
Jan. 1978		
24	EPA	W. Helphingstine
	SWRCB	C. Swanson
25	EIP	S. Krenzelok
27	USGS	Public Information Officer
	U.S. Army COE	R. Collins
Feb. 1978		
5	U.S. Army COE	R. Collins
8	ABAG	R. Diridon
28	RWQCB	R. Roche
March 1978		
20	SWRCB	Curtis Swanson
		Howard Wright
		Mike Falkenstein
	RWQCB	R. Roche
	State Health	R. Witt
	SFBNWR	R. Personius
	City of San Jose	F. Belick
		R. R. Blackburn

21	California Fish and Game	D. Kohlhorst
28	California Fish and Game	D. Kohlhorst
30	California Fish and Game	K. Anderson
April 1978		
7	Steinhert Museum, San Francisco	J. Biode
10	California Fish and Game	W. Dolstrom P. Peskins
	City of Palo Alto, Parks and Open Space	Larry White
	SFBNWR	B. Carb
	California Fish and Game	J. Swanson
	Santa Clara County Planning Department	Bob Sturdevant G. Francis E. Young
April 1978		
11	San Mateo County Planning Department	Wm. Rozar
	ABAG	Stan Hoffman
12	ABAG	K. Grazer
13	California Dept. of Finance	I. Hambright
	RWQCB	N. Rial
	EPA	E. Yunter
14	Leslie Salt Co.	Blair Armstrong
17	Leslie Salt Co.	Guy Wilkinson
	City of Sunnyvale Planning Dept.	D. Gates
	City of Palo Alto Planning Dept.	G. Zimmerman
20	City of Palo Alto Planning Dept.	B. Crowder
	Palo Alto Baylands Reserve	J. Walton
May 1978		
5	SWRCB	Curtis Swanson Howard Wright Bob Brown
	EPA	Wm. Helphingstine
	RWQCB	R. Roche S. Morse
	City of Santa Clara	R. Mortenson
	City of San Jose	F. Belick R. R. Blackburn
	City of Palo Alto	R. Remmel
	Santa Clara County	Wm. Mapes
	State Health	R. Witt
17	SWRCB	Curtis Swanson
	City of San Jose	R. R. Blackburn
June 1978		
13	San Jose/ Santa Clara WPCP	Willis Lane

15-16	EPA - Cinnati, Ohio	E. Cox D. Sany
	EPA - Washington, D.C.	A. Corsin
	EPA - Region IX	P. Cleary R. Beckwith F. Krieger
29	SBDA/San Jose	R. R. Blackburn
	SWRCB	Curtis Swanson Howard Wright
	RWQCB(2)	Robert Roche
July 1978		
5	California Fish and Game	John Day Dick Hanson
	SWRCB	Ray Dunham
	Palo Alto	Ray Remmel
	Sunnyvale	D. Somers
	San Jose	F. M. Belick
6	RWQCB	R. Roche
	SWRCB	C. Martin

LETTERS OF COMMENT RECEIVED

Jan. 1974		
7	BAAPCB	D. A. Levaggi
	San Mateo Co. Engineer and Road Commissioner	S. H. Cantwell, Jr.
	LAFCO	B. Sherman Coffman David A. Dorfman
Jan. 1974		
15	Adam E. Treganza Anthropology Museum	James Dotta, Curator
16	City of Santa Clara	Dr. Von Raesfeld, City Manager Wm. A. Gissler, Councilman R. R. Mortenson, Director Water-Sewer Ut.
17	Adam E. Treganza Anthropology Museum — San Mateo County Historical Sites Commission	Stephen R. Dietz Archaeologist
	Dept. of Parks and Recreation	Russell W. Porter James P. Tryner
21	Division of Planning and Research, SWRCB	Robert H. Lewis
25	State Lands Commission	C. R. Kirks
29	County Sanitation Dist. No. 4, Santa Clara County	S. H. Goodman, Manager and Engineer
Feb. 1974		
5	City of Fremont	Herbert Epstein, Chief Planner
	Santa Clara Valley Water Dist.	Leo F. Cournoyer Division Engineer
6	Santa Clara Co. Dept. Public Works	James T. Potts, Dir. F. D. Hodge, Mgr. Real Estate Div.
	Santa Clara Valley Water Dist.	Patrick T. Ferraro, Director Second Dist.
7		Candace M. King
8	City of Manlo Park	Leon C. Pirofalo, Director Menlo Community Development
13	League of Women Voters of San Mateo County	Linda Craig, County Council
	San Mateo Co. Public Health Engineer	H. F. Eich

14	San Mateo Co. Planning Dept.	Anne Parke
	County of San Mateo	Robert Van Horn
27	San Jose State Univ.	James P. Heath, Professor Zoology
May 1974		
22	San Mateo County Planning Dept.	Anne Parke
June 1974		
3	Air Resources Board	William C. Lockett
10	San Mateo Co. Planning Dept.	Richard Shrieve, Secretary
17	U.S. Geological Survey	Joel M. Johanson
	State Dept. Parks and Recreation	Russell W. Porter, Chief Grants and Studies Div.
22	Dept. of Transportation	B. C. Bachtold, Deputy District Director
	NASA/Ames	Loren G. Bright, Director Research Support
July 1974		
22	Dept. of the Army San Francisco Dist. Corps of Engineers	H. E. Page, Jr., Chief Engineering Division
23	RWQCB	F. H. Dierker, Exec. Office R. B. James, Acting Exec. Office
	Dept. of the Navy, Naval Air Station Moffett Field	H. L. Dozier, Jr., Commander CEC USN Public Works Officer
24	State Water Resources Control Board	Bill B. Dendy, Executive Office
25	USDI U.S. Fish and Wildlife Serv., Bureau of Sport Fisheries and Wildlife, Div. of River Basin Studies	James D. Carson, Acting Field Supervisor
29	County of Alameda, Public Works Agency	Herbert G. Growle, Director
30	California Air Resources Board	Wm. C. Lockett, Chief, Evaluation and Planning
Oct. 1974		
15	San Mateo County Planning Dept.	Roman Gankin, Senior Env. Planner
30	ABAG	Waide Egener, Principal Planner, Plan and Project Review
Jan. 1975		
23	State Water Resources Control	Larry E. Walker, Div. Chief, Manager - Clean Water Grant Program Raymond Walsh
April 1975		
5	City of Sunnyvale	D. M. Somers, Director of Public Works
8	Paul N. McCloskey, Jr., U.S. Congress, Representative of the 12th District, California, in response to a letter from E. L. Mitchell, California Canners and Growers, dated 12 March 1975	
15	NCC Food Corporation	M. P. Felice, General Production Manager

June 1975		
2	Norman Y. Mineta, U.S. Congress, Representative of the 13th District, California, in response to a letter from L. K. Taber, Canners League of America, to Congressman J. Wright, dated 23 May 1975	
July 1975		
28	Santa Clara County Medical Society	Kenneth Hayes, M.D., Chairman Environmental Health Committee
Aug. 1975		
20	Santa Clara	Eddie Souza Resident of Agnew area, Santa Clara
21	Wildlife Refuge Cttee.	Paul McKeehan, Chairman
	California Canners and Growers	R. L. Mitchell, V. P. Research
22	Bay Area League of Industrial Assns., Inc.	Herbert Stone, Chairman Water Committee
27	Santa Clara Chamber of Commerce	Owen Reeves, V.P., Industrial Citizens Division
Sept. 1975		
2	State of California Dept. of Health	M. E. Stewart, Supervising Sanitary Engineer, Reg. I
22	City of Santa Clara	R. Mortenson, Dir. of Water and Sewer Utilities, and W. A. Gissler, City Councilman
29	Cooperative Extension, U.C. County of Santa Clara	P. J. Lert, County Director
30	San Jose/ Santa Clara Water Pollution Control Plant	F. M. Belick, Engineer-Manager
Oct. 1975		
1	U.S. Army Corps of Engineers	R. C. Riddle, Acting Chief, Engineering
	County of Santa Clara	E. H. Pearl, Public Health
	U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge	R. F. Nugent, Acting Manager
2	California State Lands Division	L. L. Patton, Supervisor Land Transactions
3	City of Mountain View	N. H. Lougee, Water Division Engineer
	ABAG	R. Wong, Regional Planner
	State Water Resources Control Board	F. W. Pierson R. Reynolds
6	U.S. Bureau of Reclamation	L. G. Christiansen, Acting Regional Planning Officer
8	Santa Clara Valley Water Dist.	D. K. Gill, Advanced Planning Manager
	City of San Jose	R. R. Blackburn, Chief, Asst. Director of Public Works
10	Environmental Protection Agency	C. H. Campbell
22	U.S. Army Corps of Engineers	H. E. Pope, Jr., Chief Engineering Division

	San Francisco Bay National Wildlife Refuge	R. G. Personius, Manager
23	U.S. Fish and Wildlife Service	J. D. Carson for F. E. Smith, Field Supervisory, Division of Ecological Services
24	State Water Resources Control Board	F. W. Pierson, R. Reynolds J. Harris
28	Regional Water Quality Control Board (2)	R. Scholar
Nov. 1975		
10	Environmental Protection Agency	C. H. Campbell
Dec. 1975		
4	San Francisco Bay National Wildlife Refuge	R. G. Personius, Manager
4	Santa Clara Valley Water District	D. K. Gill, Advanced Planning Manager
5	City of Santa Clara	R. Mortenson, Director, Water and Sewer Utilities
8	Agricultural Extension UC	R. S. Ayers
Dec. 1975 (Cont'd)		
9	City of San Jose	R. R. Blackburn, Chief, Asst. Director of Public Works
10	State Dept. of Water Resources	F. W. Pierson R. Reynolds
11	State Dept. of Health	H. R. Witt, Water Sanitation tation Section 53
12	U.S. Fish and Wildlife Service	J. D. Carson For F. E. Smith Division of Ecol. Serv.
	Black and Veatch	H. J. Lobb
16	City of Santa Clara	R. R. Mortenson, Dir., Water and Sewer Utilities
22	Environmental Protection Agency	C. H. Campbell
Jan. 1976		
19	San Francisco Bay National Wildlife Refuge	R. F. Nugent, Acting Manager
20	City of Sunnyvale	D. M. Somers, Director, Public Works
21	U.S. Fish and Wildlife	F. E. Smith, Director, Ecol. Serv.
22	City of Palo Alto	R. Remmel, Chief Engineer, Water-Gas-Sewer Division
23	San Jose/ Santa Clara WPCD	F. M. Belick, Engineer-Manager
27	SBDA	R. Blackburn
28	SBDA	R. Blackburn
	Santa Clara Co. Health	E. Pearl
30	SWRCB	J. Harris
Feb. 1976		
2	City of San Jose	E. Becker F. Belick
26	SWRCB	F. W. Pierson
Mar. 1976		
4	EPA	C. Campbell
June 1976		
29	City of San Jose	R. R. Blackburn
Feb. 1977		
6	San Jose State Univ.	Dr. H. T. Harvey

March 1977		
Undated	California Academy of Sciences	W. L. Lee
May 1977		
16	Santa Clara Cooperative Extension	P. Lert
17	DWR	D. Finlayson
23	Palo Alto	N. Holmes
June 1977		
17	DWR	D. Finlayson
27	RWQCB	G. L. Johnston
July 1977		
11	City of Santa Clara	R. Mortenson
Aug. 1977		
10	SCVWD	L. F. Cournoyer
31	EPA	W. Helphingstine
Undated	U.C. Davis	R. S. Ayers
Sept. 1977		
14	California Fish and Game	E. V. Toffoli
29	State Dept. of Health	H. R. Witt
Oct. 1977		
3	EPA	W. Helphingstine
4	USBR	J. E. Cook
21	Santa Clara Co. Coop. Extension	P. J. Lert
Nov. 1977		
8	EPA	W. Helphingstine
Jan. 1978		
11	EPA	W. Helphingstine
25	RWQCB	F. H. Dierker
Mar. 1978		
13	Leslie Salt Co.	M. Blair Armstrong
17	SWRCB	H. Wright
April 1978		
21	RWQCB	F. H. Dierker
24	Cooperative Extension County of Santa Clara	P. Lert
25	EPA	W. Helphingstine
26	EPA	W. Helphingstine
May 1978		
10	RWQCB	R. Roche
	EPA	W. Helphingstine
12	SWRCB	C. Swanson
June 1978		
12	Harvey and Stanley Associates, Inc.	H. T. Harvey, Ph.D.
13	San Jose State Univ.	H. S. Shellhammer, Ph.D.
	San Jose State Univ.	L. R. Mewaldt, Professor Emeritus
16	South Bay Institute for Avian Studies	Michael Rigney
29	RWQCB	F. H. Dierker, Executive Officer
39	City of San Jose	R. R. Blackburn, Chief Asst. Dir. Public Works
July 1978		
7	EPA	Wm. Helphingstine

VII.4 DISTRIBUTION LIST

The following distribution list was compiled from an EPA list of required federal and state recipients and from lists submitted by staffs of agencies represented on the South Bay Dischargers Authority Technical Advisory Committee. In addition, those individuals who attended the public workshop or who have requested copies have been included on this list.

s = summary volume
f = full volume (including summary)

VII.4.1 FEDERAL AGENCIES

U.S. Environmental Protection Agency
Office of Legislation A-103
Congressional Affairs Division
Washington, D.C. 20460 f2

U.S. Environmental Protection Agency
Office of Public Affairs A-107
Washington, D.C. 20460 f2

U.S. Environmental Protection Agency
Office of Water Programs Operations
Oil and Special Material Control Division (WH-548)
Washington, D.C. 20460 f2

U.S. Environmental Protection Agency
Office of Federal Activities A-104
(Attn: Susan Watkins)
Washington, D.C. 20460 f10

U.S. Environmental Protection Agency
Region IX, EPA Library
215 Fremont Street
San Francisco, CA 94105 f2

U.S. Environmental Protection Agency
Public Reference Unit (PM 213) Room 2922
401 M Street, SW
Washington, D.C. 20460 f2

U.S. Environmental Protection Agency
Region IX - Attn: Bill Helphingstine
215 Fremont Street
San Francisco, CA 94105 f2

U.S. Environmental Protection Agency
Region IX - Attn: Mr. Chuck Flippo
Public Information Center
215 Fremont Street f20,
San Francisco, CA 94105 s20

Council on Environmental Quality
722 Jackson Place, NW
Washington, D.C. 2006 f5

United States Department of Agriculture
Agricultural Extension Service
Attn: Robert Ayers
University of California
Berkeley, CA 94705 f

U.S. Department of Agriculture
Office of the Secretary
Environmental Quality Activities - Room 307A
14th & Independence Avenue, SW
Washington, D.C. 20250 f2

U.S. Department of Agriculture
Soil Conservation Service
P.O. Box 1019
Davis, CA 95616 s

U.S. Department of Agriculture
Regional Forester
630 Sansome Street
San Francisco, CA 94111 s

U.S. Army Corps of Engineers
Environmental Resources Branch
South Pacific Division
630 Sansome Street
San Francisco, CA 94111 f3

U.S. Army Corps of Engineers
Environmental Branch
211 Main Street
San Francisco, CA 94105 f2

U.S. Army Corps of Engineers
Executive Director of Civil Works
Office of the Chief of Engineers
Washington, D.C. 20314 f2

U.S. Department of Defense
Deputy Assistant Secretary of Defense
Environmental Quality
OASD (HE), Pentagon
Washington, D.C. 20301 f

U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814 s

U.S. Department of the Interior
Assistant Secretary, Program Policy
Attn: Office of Environ. Project Review
Washington, D.C. 20240 f20

U.S. Department of the Interior
Western Division
P.O. Box 36063
450 Golden Gate Avenue
San Francisco, CA 94102 s

U.S. Department of the Interior
Bureau of Sport Fisheries and Wildlife
650 Capitol Mall, Room 40616
Sacramento, CA 95813 s

San Francisco National Wildlife Refuge
Attn: Robert Personius
3849 Peralta Blvd.
Fremont, CA 94536 f

U.S. Fish and Wildlife Service
Attn: Rick Breitenbach
800 Cottage Way
Sacramento, CA 95825 s

U.S. Fish and Wildlife Service
Bureau of Sport Fisheries
P.O. Box 3737
1500 N.E. Irving Street
Portland, Oregon 97208 s

U.S. Department of the Interior
Bureau of Reclamation
Attn: Haydn C. Lee, Jr.
2800 Cottage Way
Sacramento, CA 95825 s

Federal Highway Administration
Office of Environmental Policy
400 7th Street, SW
Washington, D.C. 20590 f2

Urban Mass Transportation Administration
Office of Program Operations
400 7th Street, SW
Washington, D.C. 20590 f2

Federal Highway Administration
Two Embarcadero Center - Room 530
San Francisco, CA 94111 s

Urban Mass Transportation Administration
Region IX - Box 36125
450 Golden Gate Avenue
San Francisco, CA 94012 s

Department of Transportation
12th Coast Guard District
630 Sansome Street
San Francisco, CA 94126 s

United States Coast Guard
Attn: N. Bell
Marine Environmental Protection Branch
Office Aids to Navigation Branch
230 Sansome Street
San Francisco, CA 94126 f

U.S. Department of Transportation
Box 36133
450 Golden Gate Avenue
San Francisco, CA 94102 f2

Dr. Billy Welch
SAF/ILE - Room 4C885
Pentagon
Washington, D.C. 20330 s

Mr. Bruce Hildebrand
Office of the Asst. Secretary of the Army
(Civil Works) - Room 2E567
Pentagon
Washington, D.C. 20310 s

Mr. Peter McDavitt
Special Asst. to the Secretary of the Navy
(Installations and Logistics)
Crystal Plaza No. 5
2211 Jefferson Davis Highway
Arlington, VA 20360 s

Department of the Navy
Moffett Field Naval Air Station
Attn: LCDR W. V. Sayner, Jr.
Assistant Public Works Officer
Moffett Field, CA 94035 f2

George H. Holdaway
NASA Ames Research Center
Mail Stop 213-1
Moffett Field, CA 94035 s

U.S. Department of Defense
Office of Health and Environment
Attn: George Marienthal
Room 3E172, Pentagon
Washington, D.C. 20301 s

J. Thompson
U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 94025 s

United States Geological Survey
Attn: D. S. McCulloch
855 Oak Grove Avenue
Menlo Park, CA 94025 s

U.S. Geological Survey
Attn: Drs. A. Grantz, F. Nichols,
D. McCullough
845 Middlefield Road
Menlo Park, CA 94025 s

U.S. Department of Health, Education and
Welfare, Region IX
50 Fulton Street
San Francisco, CA 94102 f2

U.S. Department of Housing and Urban
Development
Environmental Clearance Officer
One Embarcadero Center, Suite 1600
San Francisco, CA 94111 s

U.S. Department of Housing & Urban Development
450 Golden Gate Avenue
San Francisco, CA 94102 f2

U.S. General Services Administration
Region IX
49 Fourth Street
San Francisco, CA 94103 s

National Comm. of Water Quality
Attn: James Larocca
1111 - 18th Street, NW
P.O. Box 19266
Washington, D.C. 20036 f2

Water Resources Council
Office of Associate Director
2120 L Street, NW, Suite 800
Washington, D.C. 20037 f2

Federal Energy Administration
Attn: Environmental Impacts Division
New P.O. Building
12th and Pennsylvania Avenue, NW
Washington, D.C. 20461 f2

U.S. Department of Commerce
Office of Environmental Affairs
Commerce Building, Room 2816
Washington, D.C. 20230 f2

U.S. Food and Drug Administration
Attn: David Alton, Regional Shellfish Consultant
50 Fulton Street
San Francisco, CA 94118 s

Advisory Council on Historic Preservation
1522 K Street
Washington, D.C. 20005 f2

Advisory Council on Historic Preservation
P.O. Box 25085
Denver, CO 80225 f

VII.4.2 LIBRARIES

Documents Librarian
Santa Clara County Library
Research Center
10400 Torre Avenue
Cupertino, CA 95014 f2

San Jose Public Library
180 W. San Carlos St. s2
San Jose, CA 95110 f

Palo Alto Public Library
1213 Newell Road s2
Palo Alto, CA 94303 f

Santa Clara County Library
7387 Rosanna Street s2
Gilroy, CA 95020 f

Santa Clara County Library
78 South Dempsey Road s2
Milpitas, CA 95035 f

Mountain View Public Library
585 Franklin Street s2
Mountain View, CA 94040 f

Library
Water Resources Center
University of California
Berkeley, CA 94720 f

Santa Clara Public Library
2635 Homestead Road s2
Santa Clara, CA 95051 f

Sunnyvale Public Library
Attn: Documents Librarian
665 West Olive Avenue s2
Sunnyvale, CA 94086 f

Santa Clara County Library
1095 North 7th Street s2
San Jose, CA 95112 f

NASA, Ames Research Center
Technical Library
Moffett Field
Sunnyvale, CA 94040 s

VII.4.3 INDIVIDUALS AND PRIVATE GROUPS

Northern California Commission for Environmental Information
P.O. Box 761
Berkeley, CA 94701 s

California Farm Bureau Federation
Attn: J. Goold
2855 Telegraph Avenue
Berkeley, CA 94705 s

California Wildlife Federation and Salmon Unlimited
890 Washington
Santa Clara, CA 95050 s

National California Commission for Environmental Information
1828 Hopkins Street
Berkeley, CA 94707 s

Bay Area League of Industrial Associations, Inc.
3640 Grand Avenue
Oakland, CA 94612 s

California Canners and Growers
312 Stockton Avenue
San Jose, CA 95126 s

California Manufacturers Association
923 - 12th Street
Sacramento, CA 95814 s

Builders Assn. of Santa Clara and Santa Cruz Counties
345 Saratoga Avenue
Santa Clara, CA 95050 s

Environmental Information Center
Environmental Studies Department
San Jose State University
125 South 7th Street
San Jose, CA 95114 s

Stanford Commission for Environmental Information
Stanford University
Medical Center, Room M-C
Stanford, CA 94301 s

Santa Clara County Landowners Association
1020 Willow Street
San Jose, CA 95125 s

San Jose Chamber of Commerce
Attn: Jim Tucker
1 Paseo de Antonio
San Jose, CA 95114 s

Central Santa Clara League of Women Voters
1142 South Genevieve Lane
San Jose, CA 95128 s

Earth Ecology
P.O. Box 254
Campbell, CA 95008 s

Sierra Club
1711 Harte Drive
San Jose, CA 95124 s

League of Women Voters of Los Gatos
19224 Dehavilland Drive
Saratoga, CA 95070 s

Ecology Action
San Jose City College
2100 Moorpark Avenue
San Jose, CA 95114 s

Central Santa Clara Valley League of Women Voters
1668 Juanita Avenue
San Jose, CA 95125 s

Marshland Development Co.
P.O. Box 205
Alviso, CA 95002 s

Sequoia Audubon Society
Attn: Ruth T. Smith
1231 Hoover Street
Menlo Park, CA 94256 s

Save Our Sloughs
c/o Nancy Holmes
843 Moana Court
Palo Alto, CA 94306 s

The Sempervirens Fund
Attn: Claude A. Look
21749 Stevens Creek Blvd.
Cupertino, CA 95014 s

League of Women Voters of California
126 Post Street
San Francisco, CA 94108 s

Peninsula Conservation Center
1176 Emerson Street
Palo Alto, CA 94301 s

Santa Clara Audubon Society
1176 Emerson Street
Palo Alto, CA 94301 s

Committee for Green Foothills
1176 Emerson Street
Palo Alto, CA 94301 s

Sierra Club
Loma Prieta Chapter
1176 Emerson Street
Palo Alto, CA 94301 f

The Nature Conservancy Northern California
Attn: Mary Jefferds
2932 Pine Way
Berkeley, CA 94705 s

California Tomorrow
Monadnick Building
681 Market Street
San Francisco, CA 94105 s

Vernon J. Smith
California Wildlife Federation
14690 Wyrick Avenue
San Jose, CA 95124 s

The Adam E. Treganza Anthropology Museum
San Francisco State University
1600 Holloway Avenue
San Francisco, CA 94132 s

Conservation Associates
220 Bush Street
San Francisco, CA 94104 s

California Native Plant Society
2490 Channing Way, Room 317
Berkeley, CA 94704 s

People for Open Space
126 Post Street, Room 607
San Francisco, CA 94108 s

Environmental Defense Fund
2728 Durant Avenue
Berkeley, CA 94704 f

Peter Sly
Natural Resources Defense Council
664 Hamilton
Palo Alto, CA 94201 f

San Francisco-Bay Area Council, Inc.
World Trade Center
San Francisco, CA 94111 s

Environmental Quality Coordinating Council
of San Mateo County
P.O. Box 219
Menlo Park, CA 94025 s

Sierra Club
San Francisco Bay Chapter
220 Bush Street
San Francisco, CA 94104 f

Save San Francisco Bay Association
P.O. Box 925
Berkeley, CA 94701 s

P.G. & E. Land Department
77 Beale Street, Room 1245
San Francisco, CA 94106 s

Mrs. Wm. McD. Eastman
13221 West Sunset Drive
Los Altos Hills, CA 94022 s

Raychem Corporation
Attn: Dick Hopkins
300 Constitution Drive
Menlo Park, CA 94025 s

Coyote Point Museum
Coyote Point
San Mateo, CA 94401 s

Environmental Information Center
San Jose State University
125 South 7th Street
San Jose, CA 95192 s

San Mateo County Development Association, Inc.
4 West 4th Avenue
San Mateo, CA 94403 s

Santa Clara Audubon Society
14875 Cole Drive
San Jose, CA 95124 s

American Society of Civil Engineers
160 Sansome Street
San Francisco, CA 94104 s

Automotive Assembly Division
Attn: R. M. Hanselman
P.O. Box 1586
Allen Park, Michigan 48101 s

Santa Clara County Landowners Association
Route 2, Box 778
San Jose, CA 95131 s

Santa Clara County Canners Association
Attn: L. K. Taber, Secty/Treas.
1007 L Street
Sacramento, CA 95814 s

Carl Harris
3708 Mt. Diablo Blvd.
Lafayette, CA 94549 s

Ken Boyd
4011 Glenwood Drive
Santa Cruz, CA 95060 s

City of Gilroy
Attn: Scott LaFauer
Gilroy, CA 95020 s

George Gritton
15045 Sycamore Avenue
Morgan Hill, CA 95037 s

George Green
P.O. Box 1368
Los Gatos, CA 95030 s

Neil Neilson
P.O. Box 1297
Los Altos, CA 94022 s

Roberta Varney
2375 Lida Drive
Mountain View, CA 94040 s

Greater East San Jose Homeowners Association
George Lydon
2788 Woodmoor Drive
San Jose, CA 95127 s

San Jose Alliance
Attn: R. Clark Roushey, President
6414 DuSalt Drive
San Jose, CA 95119 s

Friends of the Earth
529 Commercial Street
San Francisco, CA 94111 s

Oceanic Society
Fort Mason Building, 240
San Francisco, CA 94123 s

Regional Parks Association
c/o Ms. Alice Q. Howard
6415 Regent Street
Oakland, CA 94612 s

C. Cammel
763 Rockdale Drive
San Francisco, CA 94127 f

W. W. Dada
Dried Fruit Assoc. of California
Box 270A
Santa Clara, CA 95052 s

Mary Anna Eklund
Return Oil & Rerefine
971 Ticonderoga Drive
Sunnyvale, CA 94037 s

Ronald Gerke
Ameron Pipe Products Group
Northern California Division
P.O. Box 3396
Hayward, CA 94540 s

A.B.M. Houston, Manager
Ford Motor Company
Compliance and Liaison Department
One Parklane Blvd., Suite 628 Parklane West
Dearborn, MI 48126 s

Dan Chapin
c/o Chapco
2200 Sand Hill Road
Menlo Park, CA 94025 s

John Jost
737 Harvard
Sunnyvale, CA 94087 s

Santa Clara Co. Medical Society
Attn: Dr. Kenneth Hayes
700 Empey Way
San Jose, CA 95128 s

Stephen D. Lux
361 Greenpark Way
San Jose, CA 95136 s

Jim Quintal
California Canners and Growers
182 South Fairoaks Avenue
Sunnyvale, CA 94086 s

Ed Ramey
Santa Clara Chamber of Commerce
Industrial Citizens Council
Santa Clara, CA 95050 s

M. L. Sellers
Lockheed Missile and Space Co.
P.O. Box 504
Sunnyvale, CA 94088 s

Eddie Souza
4320 Bassett Street
Santa Clara, CA 95054 s

Bea Brown
Santa Clara Valley Coalition
485 Aspen Way
Los Altos, CA 94022 s

E. L. Mitchell
312 Stockton Avenue
San Jose, CA 95126 s

R. Ilse and W. Doucett
182 South Fairoaks Avenue
Sunnyvale, CA 94086 s

American Association of University Women
1165 Minnesota Avenue
San Jose, CA 95125 s

Julie Stephenson
1742 McBain Avenue
San Jose, CA 95125 s

People for Open Space
46 Kearny Street, Room 400
San Francisco, CA 94108 s

Mr. Thomas O. Chan, Senior Engineer
San Francisco Water Department
425 Mason Street
San Francisco, CA 94102 s

The Nature Conservancy
215 Market Street
San Francisco, CA 94105 s

Ms. Jane Baron
232 Hillview Avenue
Los Altos, CA 94022 s

Mr. Walter V. Hays
111 W. St. John Street
San Jose, CA 95113 s

J. B. Gilbert & Associates
Claremont Hotel
Berkeley, CA 94705 s

George S. Nolte & Associates
Attn: Charles Hall
1731 N. First Street
San Jose, CA 95112 s

William Spangle & Associates
Attn: George Mader
3240 Alpine Road
Portola Valley, CA 94025 s

H. E. Stone
Bay Area League of Industrial Assns.
P.O. Box 3575
San Francisco, CA 94119 f

Ford Motor Company
P.O. Box 1101
San Jose, CA 95108 s

Santa Clara Co. Canners Assoc.
Mr. Edward Mitchell, President
312 Stockton Avenue
San Jose, CA 95126 f

Textile Service Industries, Inc.
Ms. Bea Slater, Secretary
958 - 28th Street
Oakland, CA 94608 s

Tri-County Apartment Assoc. Inc.
Mr. Laurence B. Mitchell, Boardmember
996 Minnesota Avenue
San Jose, CA 95125 s

Paul McKeehan
890 Washington Street
Santa Clara, CA 95050 s

Mr. John Sampson
3992 Bibbits Drive
Palo Alto, CA 94303 s

Jan Bridges
615 South Main Street
Milpitas, CA 95035 s

Patrick T. Ferraro
351 Brookwood Drive
San Jose, CA 95116 s

Jessi Vosti
500 W. Middlefield, No. 175
Mountain View, CA 94043 s

Charles Bigelow
873 Santa Cruz Avenue
Menlo Park, CA 94025 s

Marion Softkey
320 Encinal Avenue
Menlo Park, CA 94025 s

Mr. Spense Havlick
Environmental Studies Dept.
San Jose State University
San Jose, CA 95114 s

Dr. H. T. Harvey
Dept. of Biological Science
San Jose State University
San Jose, CA s

Brown and Caldwell
Attn: John T. Bovey
1501 N. Broadway
Walnut Creek, CA 94596 s

Rene Fuog
531 Sierra Avenue
Mountain View, CA 94041 s

Dr. R. G. Spicker
Civil Engineering
San Jose State University
San Jose, CA 95114 s

Dr. G. E. Lindsay
California Academy of Sciences
Golden Gate Park
San Francisco, CA 94118 s

Dr. Robert E. Selleck
Sanitary Engineering Res. Lab.
U.C. Berkeley
Berkeley, CA 94720 s

Consoer-Townsend & Associates
1671 The Alameda
San Jose, CA 95126 s

Jenks and Adamson
543 Byron Street
Palo Alto, CA 94301 s

Kennedy Engineers
657 Howard Street
San Francisco, CA 94105 s

Metcalf and Eddy
1029 Corporation Way
Palo Alto, CA 94303 s

California Builders Council
925 L Street, Suite 700
Sacramento, CA 95814 s

Bay Area Clean Waters Commission
1450 Creekside Drive
Walnut Creek, CA 94596 s

Conservation Coordinators
P.O. Box 4161
Woodside, CA 94062 s

Sierra Club
P.O. Box 282
Hayward, CA 94543 s

Bay Area Planning Directors Assoc.
835 East 14th Street
San Leandro, CA 94577 s

Ecology Center
2179 Alston Way
Berkeley, CA 94704 s

Assoc. Sportsman of California
2636 Judah Street
San Francisco, CA 94122 s

Stanford University
Sponsored Projects Information Center
Attn: Kathy Walby
Stanford, CA 94305 s

Stanford Conservation Group
Tresidder Union
Stanford University
Stanford, CA 94305 s

California Federation of Labor
995 Market Street
San Francisco, CA 94102 s

Bay Area Clean Water Council
5009 Charles Avenue
El Cerrito, CA 94530 s

South County Ecology Center
18313 Pepper Street
Castro Valley, CA 94546 s

TRI-City Ecology
2754 Olive Avenue
Fremont, CA 94538 s

League of Women Voters
P.O. Box 2638
Fremont, CA 94536 s

California Native Plant Society
2490 Channing Way, Room 317
Berkeley, CA 94705 s

Sierra Club
Air Pollution Task Force
340 Johnson Avenue
Los Gatos, CA 95030 s

Chabot College
2555 Hesperian Blvd.
Hayward, CA 94545 s

Trustees for Conservation
170 Arlington Avenue
Berkeley, CA 94707 s

Ecology Center of San Francisco
13 Columbus Avenue
San Francisco, CA 94111 s

Los Altos Chamber of Commerce
321 University Avenue
Los Altos, CA 94022 s

Mountain View Chamber of Commerce
580 Castro
Mountain View, CA 94040 s

Menlo Park Chamber of Commerce
1100 Merrill
Menlo Park, CA 94025 s

Palo Alto Chamber of Commerce
2 Palo Alto Square
Palo Alto, CA 94304 s

Sunnyvale Chamber of Commerce
South Murphy Avenue and West Olive Avenue
Sunnyvale, CA 94036 s

Santa Clara Chamber of Commerce
1515 El Camino Road
Santa Clara, CA 95050 s

Cupertino Chamber of Commerce
10300 South Saratoga-Sunnyvale Road
Cupertino, CA 95014 s

San Mateo Co. Historical Museum Assoc.
1700 West Hillsdale Blvd.
San Mateo, CA 94402 s

Historical Heritage Commission
County of Santa Clara
70 West Hedding Street, Room 524
San Jose, CA 95110 s

Department of Anthropology
Cabrillo College
6500 Soquel Drive
Aptos, CA 95003 s

Don Sandberg
Ruth, Going, Curtis
919 The Alameda
P.O. Box 4591
San Jose, CA 95159 s

Loma Prieta Chapter
Sierra Club
SBDA Committee
1176 Emerson
Palo Alto, CA 94301 f

Steve Krenzelok
Environmental Impact Planning Corporation
319 11th Street
San Francisco, CA 94103 s

Michael Filice
NCC Food Corporation
570 Race Street
San Jose, CA 95126 f

Assoc. General Contractors of Calif. Inc.
301 Capitol Mall
Sacramento, CA 95814 s

Betty Joyce Limysk
956 Trophy Drive
Mountain View, CA 94040 s

Gary Stevens
Biology Department
University of San Francisco
San Francisco, CA 94117 s

Martin Seldon
c/o Varian
611 Hansen Way
Palo Alto, CA 94303 s

Prof. Perry L. McCarty
Civil Engineering Dept.
Stanford University
Stanford, CA 94305 s

Myron Tatarian
Public Works Department
City Hall, Room 260
San Francisco, CA 94102 s

A. H. Frye, Jr.
San Francisco Water District
425 Mason
San Francisco, CA 94102 s

Southern Pacific Transportation Company
Attn: J. W. Zwick
1 Market Street
San Francisco, CA 94105 s

Leslie Salt Company
7220 Central Avenue
Newark, CA 94560 s

Bechtel, Inc.
Attn: Carol M. Harper 301/4/B10
P.O. Box 3965
San Francisco, CA 94119
f(18)

Michael Melanson
3717 Winston Way
Carmichael, CA 95608 f

Archaeological Consulting and
Research Services, Inc.
20 Evergreen Ave.
Mill Valley, CA 94941 f

E. H. Smith and Associates
Attn: E. H. Smith
4090 Harrison Grade Road
Sebastopol, CA 95472 f

Hydroscience, Inc.
Attn: D. Szunsky
2815 Mitchell Dr.
Walnut Creek, CA 94598 f2

Pacific Environmental Laboratory
Attn: T. Nakamura
657 Howard St.
San Francisco, CA 94105 f

R. C. Harlan and Associates
Attn: R. C. Harlan
Suite 401, Sharon Building
55 New Montgomery
San Francisco, CA 94105 f

VII.4.4 STATE AGENCIES

California State Office of Intergovernmental
Management
Attn: Mark Briggs, Room 108
1400 - 10th Street
Sacramento, CA 95814 f20

State Water Resources Control Board
Attn: Wayne Pierson
P.O. Box 100
Sacramento, CA 95801 f

State Department of Public Health
Attn: William Joppling
2151 Berkeley Way
Berkeley, CA 94704 f

University of California at Davis
Attn: Dr. Robert Hagen
Davis, CA 95616 f

Regional Water Quality Control Board
San Francisco Bay Region
Attn: Robert Scholar
1111 Jackson Street
Oakland, CA 94607 f

State Attorney General's Office
6000 State Building
350 McAllister Street
San Francisco, CA 94102 s

State Water Resources Control Board
Attn: Curtis Swanson
P.O. Box 100
Sacramento, CA 95801 f

State Office of Historic Preservation
1416 9th Street
Sacramento, CA 95814 f

Agricultural Extension Service
University of California
County of Santa Clara
Attn: Peter Lert
215 N. First Street
San Jose, CA 95113 f

VII.4.5 REGIONAL AGENCIES AND LOCAL GOVERNMENT

Bay Area Air Pollution Control District
939 Ellis Street
San Francisco, CA 94109 f

San Francisco Bay Conservation and
Development Commission
Attn: Patty Weesner
30 Van Ness Avenue
San Francisco, CA 94102 f

Metropolitan Transportation Commission
Hotel Claremont
Berkeley, CA 94705 s

Association of Bay Area Governments
Attn: Robert Wong
Claremont Hotel
Berkeley, CA 94705 f

Santa Clara County Health Department
Attn: E.H. Pearl
2220 Moorpark Avenue
San Jose, CA 95128 f

San Benito County Board of Supervisors
Attn: George E. Shore, Chairman
Courthouse, Room 204
Hollister, CA 95023 f

South Bay Dischargers Authority
Attn: Mr. A.R. Turturici, Director
City of San Jose Public Works Department
801 North First Street
San Jose, CA 95110 f

City of San Jose
Attn: City Manager
801 North First Street
San Jose, CA 95110 s

City of San Jose
Planning Department
801 North First Street
San Jose, CA 95110 f

City of Santa Clara
Attn: Robert R. Mortenson
1500 Warburton Avenue
Santa Clara, CA 95059 f

City of Hayward
Planning Department
22300 Foothill Blvd.
Hayward, CA 94541 s

City of Campbell
Planning Department
75 N. Central Avenue
Campbell, CA 95008 s

City of Newark
Planning Department
37101 Newark Blvd.
Newark, CA 94560 s

City of Fremont
Planning Department
39700 Civic Center Drive
Fremont, CA 94538 s

City of Palo Alto
Attn: City Manager
250 Hamilton Street
Palo Alto, CA 94301 s

City of Mountain View
Attn: Norman H. Lougee
540 Castro Street
Mountain View, CA 94041 f

City of Sunnyvale
Attn: City Manager
456 Olive Avenue
Sunnyvale, CA 94088 s

City of Santa Clara
Planning Department
1500 Warburton Avenue
Santa Clara, CA 95050 f

City of Mountain View
Planning Department
540 Castro Street
Mountain View, CA 94040 f

City of Sunnyvale
Planning Department
P.O. Box 607
456 W. Olive Avenue
Sunnyvale, CA 94088 f

City of Los Altos
Planning Department
1 N. San Antonio Road
Los Altos, CA 94022 f

City of Palo Alto
Planning Department
Attn: Elizabeth Crowder
250 Hamilton Street
Palo Alto, CA 94301 f

City of Menlo Park
Director of Community Development
Civic Center
Menlo Park, CA 94025 f

City of San Mateo
Planning Department
330 W. 20th Avenue
San Mateo, CA 94402 s

City of Redwood City
Planning Department
1017 Middlefield Road
Redwood City, CA 94063 s

City of Milpitas
Planning Department
455 E. Calaveras Blvd.
Milpitas, CA 95035 f

City of Cupertino
Planning Department
City Hall, 10300 Torre Avenue
Cupertino, CA 95014 f

Town of Los Altos Hills
Planning Department
26379 Fremont Road
Los Altos Hills, CA 94022 f

City of Union City
Planning Department
1154 Wipple Road
Union City, CA 94587 s

City of Los Gatos
Planning Department
P.O. Box 949
Los Gatos, CA 95030 f

City of Monte Sereno
Planning Department
18041 Saratora-Los Gatos Road
Monte Sereno, CA 95030 f

City of Palo Alto
Attn: Mr. H.R. Remmel
250 Hamilton Avenue
Palo Alto, CA 94301 f

City of Sunnyvale
Attn: D.M. Somers
456 West Olive Avenue
P.O. Box 607
Sunnyvale, CA 94088 f

San Mateo County Board of Supervisors
County Government Center
Redwood City, CA 94063 s

South Santa Clara Valley Water Conservation District
Attn: Mike Sheehy
7951-B Wren Avenue
Gilroy, CA 95020 f

Agricultural Extension Service
University of California
County of San Benito
Attn: Edward Lydon
P.O. Box 820
Hollister, CA 95023 f

Santa Clara Valley Water District
Attn: Lloyd Fowler, Chief Engineer
5750 Almaden Expressway
San Jose, CA 95118 f

Santa Clara County Board of Supervisors
Attn: County Executive
70 West Hedding Street
San Jose, CA 95110 f

San Jose/Santa Clara Treatment Plant
Advisory Committee
Waste Pollution Control Plant
700 Los Esteros Road
San Jose, CA 95131 f

East Bay Dischargers Authority
Attn: Wayne Bruce
22300 Foothill Blvd.
Hayward, CA 94541 f

Menlo Park Sanitary District
500 Laurel Street
Menlo Park, CA 94025 f

Cupertino Sanitary District
20065 Stevens Creek Blvd.
Cupertino, CA 95014 f

Santa Clara County Sanitation District No. 4
100 E. Sunnyoaks Drive
Campbell, CA 95008 f

N. Daniels, General Manager
Union Sanitary District
4057 Baine Avenue
Fremont, CA 94536 s

Strategic Consolidation Sewerage Agency
666 Elm Street
San Carlos, CA 94020 s

Santa Clara County
Planning Department
70 West Hedding
San Jose, CA 95110 f

City of San Jose
Planning Department
130 Park Center Plaza
San Jose, CA 95135 f

Santa Clara County
Parks and Recreation Department
70 West Hedding
San Jose, CA 95110 s

Santa Clara County
Public Works Department
1555 Berger Drive
San Jose, CA 95112 s

San Mateo County
Planning Department
County Government Center
Redwood City, CA 94063 f

San Mateo County
Attn: Henry F. Eich
Office of Environmental Health
590 Hamilton Street
Redwood City, CA 94063 s

San Mateo County
Parks and Recreation Department
County Government Center
Redwood City, CA 94063 s

San Mateo County
Engineering Department
County Government Center
Redwood City, CA 94063 s

Alameda County Planning Department
399 Elmhurst
Hayward, CA 94544 s

County of San Benito
Attn: County Executive
Hollister, CA 95023 f

Mid-Peninsula Regional Park District
c/o Herbert Grench
745 Distell Drive
Los Altos, CA f

Parks and Recreation Department
Vasona Park
300 Garden Hill Drive
Los Gatos, CA 95030 s

Bay Area Rapid Transit District
800 Madison Street
Oakland, CA 94601 s

San Benito County Farm Bureau
Veterans Memorial Building
Hollister, CA 95023 s

Santa Clara County Grand Jury
Attn: Phyllis Austin
26650 St. Francis Drive
Los Altos Hills, CA 94022 f

Santa Clara County Farm Bureau
186 E. Gish Road
San Jose, CA 95112 s

LAFCO
1221 Oak Street
Oakland, CA 94612 f

San Francisco City and County Board of Supervisors
City Hall
San Francisco, CA 94102 s

California Farm Bureau
Attn: William Du Bois
11th and L Streets
Sacramento, CA 95011 s

Mr. Richard R. Blackburn
South Bay Dischargers Authority
801 North First Street
San Jose, CA 95110 f

Mr. Frank Belick, Engineer-Manager
San Jose/Santa Clara Water Pollution Control Plant
700 Los Esteros Road
San Jose, CA 95131 f

Mr. Don Atkinson, Division Chief Attorney
City Attorney's Office
151 West Mission Street, Room 151
San Jose, CA 95110 f

Mr. William A. Gissler, Chairman
South Bay Dischargers Authority
1500 Warburton Avenue
San Jose, CA 95050 f

Ms. Janet Gray Hayes
South Bay Dischargers Authority
801 North First Street
San Jose, CA 95110 f

Ms. Suzanne Wilson
South Bay Dischargers Authority
801 North First Street
San Jose, CA 95110 f

Mr. Alan Henderson
South Bay Dischargers Authority
765 San Antonio Road, #81
Palo Alto, CA 94303 f

Mr. Gilbert Gunn
South Bay Dischargers Authority
1693 Kitchener
San Jose, CA 94087 f

VII.4.6 LEGISLATORS

Honorable S. I. Hayakawa
United States Senator
452 Senate Office Bldg.
Washington, D.C. 20510 f

Honorable Alan Cranston
United States Senator
452 Senate Office Bldg.
Washington, D.C. 20510 f

Honorable Norman Y. Mineta
Member of Congress, 13th District
510 Cannon House Office Bldg.
Washington, D.C. 20515 f

Honorable Don Edwards
United States Congressman
2240 Rayburn Office House Bldg.
Washington, D.C. 20515 f

Honorable Paul N. McCloskey, Jr.
United States Congressman
205 Cannon House Office Bldg.
Washington, D.C. 20515 f2

Honorable Edmund Brown, Jr.
Governor of California
Sacramento, CA 95814 f

Honorable John Garamendi
State Senator, District 13
State Capitol
Sacramento, CA 95814 f

Honorable Arlen Gregorio
State Senator, District 10
State Capitol
Sacramento, CA 95814 f

Honorable Jerry Smith
State Senator, District 12
State Capitol
Sacramento, CA 95814 f

Honorable Victor Calvo
State Assemblyman, District 21
State Capitol
Sacramento, CA 95814 f

Honorable Leona H. Egeland
State Assemblywoman, District 24
State Capitol
Sacramento, CA 95814 f

Honorable Richard D. Hayden
State Assemblyman, District 22
State Capitol
Sacramento, CA 95814 f

Honorable Alister McAlister
State Assemblyman, District 25
State Capitol
Sacramento, CA 95814 f

Honorable John Vasconcellos
State Assemblyman, District 23
State Capitol
Sacramento, CA 95814 f

VII.4.7 NEWS MEDIA

San Jose Sun Newspapers
Attn: Mort Levine
10950 N. Blaney
Cupertino, CA 95014 s

San Jose Mercury and News
Attn: Tom Harris
750 Ridder Park Drive
San Jose, CA 95113 s

Menlo-Atherton Recorder
640 Roble Avenue
Menlo Park, CA 94025 s

Suburban Newspapers
Attn: Susan Cohen
615 So. Main Street
Milpitas, CA 95035 s

San Mateo Times and News Leader
1080 S. Bayshore Blvd.
San Mateo, CA 94402 s

East San Jose Sun
Attn: Tom Gilsenon
615 So. Main Street
Milpitas, CA s

Palo Alto Times
Attn: Bob Burgess
Box 300
Palo Alto, CA s

San Francisco Chronicle
925 Mission Street
San Francisco, CA 94103 s

San Francisco Bay Guardian
1970 Bryant Street
San Francisco, CA 94103 s

San Francisco Examiner
Attn: Carl Irving
Box 3100
San Francisco, CA 94119 s

Oakland Tribune
13th and Franklin Streets
Oakland, CA 94612 s

KGO TV — Channel 7
277 Golden Gate Avenue
San Francisco, CA 94102 s

KQED TV — Channel 9
1011 Bryant Street
San Francisco, CA 94103 s

Margaret Race
KQED TV — Channel 9
500 8th Street
San Francisco, CA 94103 f

KPIX TV — Channel 5
2655 Van Ness
San Francisco, CA 94109 s

KRON TV — Channel 4
1001 Van Ness Avenue
San Francisco, CA 94119 s

KNTV — Channel 11
645 Park Avenue
San Jose, CA 95126 s